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INDUSTRY AND EDUCATION

NO one would doubt, even in normal times, that the relations between industry and education are of fundamental importance to the planning of our life as a nation. The War has heightened that importance. It has "already brought with it changes in the structure and working of industry, above all on the human side, much further-reaching than those which developed during the last war". That quotation occurs in a statement on "Industry and Education"* which has been issued as a result of a conference between educationists and industrialists held towards the end of last year, under the auspices of Nuffield College, Oxford.

We commend the statement to the careful consideration of our readers. It does not, as its authors are at pains to point out, pretend to anything which is to be regarded as a scheme—final, rounded and authoritative. It embodies suggestions, and the aim of submitting those suggestions has been to provoke discussion and "to test the degree of agreement which exists among our colleagues in industry, in the universities and technical colleges, and in other walks of life".

The statement opens by laying down the fact that, after the War, our hope for steady and speedy advancement in wealth and welfare depends upon the extent to which we are able "to produce efficiently and cheaply a wide range of goods for consumption overseas as well as at home". In other words, all plans for advancing our standards of living "must depend, in the last resort, on the efficiency of British production and on the ability of British industry to sell goods in the world market".

How is that to be done? The call for "cheap production" is very often linked with an emphasis on the need for "cheap labour". Such a solution is dismissed at once. Any attempt to solve the problem on the basis of low-wage competition is bound, says the statement, to end in failure. We must, instead, look to the quality of our labour and to the "attitude towards production of individuals who comprise the labour force", for they are the vital factors in raising productivity to a satisfactory level. Labour which is badly paid and discontented is never really cheap.

To secure quality of labour a planned scheme of education is essential, and it is here that the statement is crystal clear in its view that, so far as those who leave school at the statutory age are concerned, industry does not ask that they shall have received any specific vocational preparation for the occupations they are about to enter. "Industry itself can best undertake the specific training of such entrants, or collaborate with educational agencies in providing if after they have left school." What is needed in the case of these young people, including those in junior technical and secondary schools, is a broadly non-vocational course. That does not mean to say that the curriculum in all these schools should follow precisely the same lines. It means that while the technical school can provide a curriculum "centring on basic mathematics and science but also paying

* Oxford University Press, 1943. 1s. net.

due attention to English and to social subjects", in a senior or secondary school "the teaching of cultural subjects will be combined with an attempt to give every pupil a sufficient grounding in elementary mathematics and in the foundations of science". The intention, for all these pupils, is to secure the speaking and writing of good and exact English and "a clear understanding of the essential character and institutions of the society" in which they will later have to play their part. Nor are these things to be regarded as separate 'subjects'. They are to be regarded as integral to the whole course and should therefore permeate the teaching of all subjects.

Even if that were accomplished, however, the statement recognizes there will still be those who may have no prospect of rising from the lower ranks of their vocations. These will include repetition workers and, although it is believed that "industry will need not less but more intelligence and adaptability as mechanisation makes further advances", it is vital to prevent that sense of thwartedness which is always a possible danger. To that end, employers should be prepared to grant these workers a dual road to self-development by broadening the avenues of advancement and by release for study not necessarily connected with their work. Who will not agree with the view that "It is no mean part of industry's responsibility to those whom it employs to ensure that both these ways of human progress shall be made broad and easy of access to all-comers"?

But while those who enter industry after the statutory school-leaving age constitute the majority, there are two other groups of entrants to industry: those who remain at secondary or technical schools after the statutory leaving age but do not proceed to full-time courses at a university or technical college, and those who enter industry either directly after a full-time university or higher technical course or after a further period of study or research following such a course.

In the case of those who enter from secondary schools a reform appears immediately necessary. It is that the course they follow should be complete in itself. What industry sees here is that at present such courses are too often devised primarily as a preparation for university courses which, in fact, are not likely to be pursued by the majority. But to attain that end "it is necessary to release the schools from thraldom to an examination system conceived too much under university influence, or rather from a standpoint which regards the school primarily as a place of preparation for university work". The technicalities are not argued, but we believe that the authors of the statement have put their fingers on a matter which is already receiving the attention of a very large number of educationists whose starting point has by no means been the same.

From these schools, again, industry asks for the broadest and deepest possible development of general intelligence and initiative, and a sound basis of general scientific and mathematical knowledge. It is just as contrary to the requirements of industry as it is to the balanced growth of the individual that there should be any premature specialization. The first essential is to make firm the foundations. When these pupils have entered industry there should be the widest possible opportunities for further education in all its phases.

The final group of entrants are those who come after full-time courses at a university or technical college. They are those who may be expected to be the main supply for the higher personnel of industry and for industrial research; and it is in connexion with their case that the statement turns a critical eye upon university scholarship examinations. If premature specialization at school is bad, the present tendency for those scholarship examinations to be unduly specialized must be altered. The statement therefore strongly urges university authorities to insist on a firm grounding in mathematics and science rather than on a high standard of specialized knowledge. We agree. Specialization is essential in the higher ranges of knowledge, but it must rest upon a broad groundwork. There is little need to emphasize even the potential danger of a 'specialist' who lacks what is called a cultural background. The phrase savours sometimes of the cliché: but we know that, whatever else it may mean, it means the ability to appreciate the wide issues of industrial organization and policy, the place which industry occupies in the community and the processes of social as well as technological development. Without that ability specialization lacks also the "qualities of leadership, initiative and imagination".

We are all familiar with the need for closer contact between industry and the universities. The statement makes important suggestions in that direction. These include the use of the staffs of industrial research laboratories to give courses of lectures to university students, and the seconding of university teachers and research workers for periods of service with the research staffs attached to particular industries. Moreover, the movement to and fro between 'pure' and industrial research could be made a good deal easier. Adjustments would be necessary, of course. Salary structures and other conditions are different, but they could and should be arranged in order to secure the end in view.

The authors of the statement believe, as we believe, that industry has a right to a higher proportion of the best men from the universities. The claim, in our view, is soundly based. If national standards are to be improved, the need to harness scientific knowledge fully to the promotion of higher industrial productivity is imperative. We know the value of the work done in this connexion by the university appointments boards; but we agree that it is not enough. For that reason we believe that the suggestion of carrying on and improving the work of the Central Register which the War has brought into being is a useful one. It would not replace or make unnecessary the closer contact between university teaching staffs and those who deal with recruitment of the higher personnel of industry; but it would be an advance in the right direction.

So much for the universities. But anyone who knows the details of industrial personnel knows the tremendous contributions made by technical colleges.

It was to be expected, therefore, that the relationship between university and technical college should be raised in any document dealing with the flow of recruits to all parts of the industrial structure. Clearly a large expansion of technical education is indicated in the future, and the proposal that the higher forms of technical education should be concentrated in the universities was bound to be examined. We are glad to note that the statement strongly dissents from that proposal. The intention may be admirable, but we agree that it is quite impracticable to separate the higher from the less advanced forms of technical education, "or to bring within the existing universities the large numbers who need higher technical training of one sort or another". The statement, therefore, supports the idea which has sometimes been expressed as the development of universities and technical colleges as the "twin tops of the educational system". The statement does not use that phrase. Instead it uses the phrase "People's University", and suggests the "making of technical colleges and other institutions which suffer from a parallel isolation and incompleteness into the nuclei of a new type of people's colleges, equipped both to train students for a wide range of vocations and to play an active part in widening the sphere of adult education". That method, it is suggested, "offers by far the best hope of endowing higher technical education with that cultural quality in which it is now too often deficient, and of constituting it a school of personality and leadership as well as technical skill". We are by no means disposed to accept all the implications of that quotation, but we need not here indicate assumptions which seem to us to lack foundation. The main idea is that of the people's college, and with that we are in cordial agreement.

Let us note in conclusion a protest made quite early in the statement. It is against the bias of the educational system against entry into manual occupations. There can be no doubt that the move towards "directing boys who are above the average intelligence into non-manual work" exists, and we agree with the protest "except where the non-manual occupations are such as to call for a high degree of intelligence". That bias against manual occupations has not, however, appeared without some reason. We recall having directed attention in these columns to at least one reason. It was so far back as November 12, 1927. What was said then bears repetition now:

"This fault of shaping the bright boy to the black suit was regarded as belonging to parents and teachers rather than to employers. But are parents and teachers to receive all the blame? Is it not generally true that difference of status exists? Is it not generally true that in times of bad trade it is the production side which suffers while the administrative side enjoys something very like permanence? Can the employer help to avoid this—a very real threat to the future and welfare of industry?"

With that in mind we direct special attention to the final passage of the statement we are noting. It is headed "The Need for Hope". It underlines the passage we have just quoted when it says: "To most workmen and to many technicians the supreme discouragement to the development and display of the higher faculties is the fear of unemployment. . . . Not one of the suggestions we have put forward will bear its full fruit unless this inhibiting tenor can be exorcised." Industry must be forward-looking and assured that it "will not be made the sport either of defective financial arrangements or of official timidity in facing fundamental economic problems". Men live and work happily when they have hope, and because of that we need not amplify further the quotations we have selected. If their main suggestions go unheeded, the rest of the statement might just as well not have been written.

COLLOIDAL AND AMORPHOUS MATERIALS

Industrial Chemistry of Colloidal and Amorphous Materials

By Prof. Warren K. Lewis, Lombard Squires and Dr. Geoffrey Broughton. Pp. xii+540. (New York: The Macmillan Company, 1942.) 5.50 dollars.

IT is related that Prof. Nernst was wont to refer to the science of colloids as *die trübe Wissenschaft* (the cloudy science). The innuendo implied in this witty remark was not without some justification at one time, but that day is long past. So great have been the advances made during the last thirty or forty years in the study of sols and gels, interfacial properties and actions, and the structure and behaviour of large molecules or micelles—from 'macro' to 'mega'—that colloid science with its many applications now occupies a position of great and growing importance, and can offer to the student of Nature not only a very large body of quantitatively well established and well correlated phenomena, but also a corresponding body of scientific principles and reasoning.

The present book, a most admirable one and unique in many respects, comes from the Chemical Engineering Department of the famous Massachusetts Institute of Technology, the senior author, Warren K. Lewis, being the well-known professor in that Department, an honorary member of the Institution of Chemical Engineers (Great Britain), and long known throughout the world to students of chemistry as one of the authors of that famous pioneering work, "Principles of Chemical Engineering", first published in 1923. The other joint authors of the present book are former members of the Chemical Engineering Department of the Massachusetts Institute of Technology and now occupy important positions as chemical engineers in two of the greatest industrial concerns of the United States, namely, the E.I. du Pont de Nemours Company and the Eastman Kodak Company. No book intended to instil into the minds of chemistry students the fundamental underlying science and many of the essential facts and phenomena relating to the processes of many great industries could come before the public with better credentials.

As the authors explain in the preface, students starting the study of fields of applied chemistry such as the so-called heavy chemical industry possess in general an adequate background of training in

inorganic, organic, analytical and physical chemistry. This is not true, however, of the great industrial field of colloidal and amorphous materials, and for two reasons. In the first place, the subject of physical chemistry is so broad that instruction to be thorough must be restricted in scope, with the result that it is not possible to deal adequately with the scientific facts and principles underlying the phenomena presented by colloid and 'amorphous' systems. In the second place, these phenomena are so complex that "many individuals prefer a purely empirical approach, but it is the conviction of the writers that it is best to submit each problem to a careful theoretical analysis, even though in the nature of the specific case this may be known to be inadequate. A major purpose, therefore, is the introduction of the student to such a method of attack".

In accordance with this admirable plan, the first 280 pages—rather more than one half of the book—are devoted to the physics and chemistry of colloids, including adsorption phenomena, large molecules, surface films, molecular orientation, and 'amorphous' solids. The treatment of these subjects is preceded by three very useful chapters dealing respectively with the structure of liquids, viscosity and surface tension. The second part of the book (pages 281–519) deals with glass, plasticization by solution (including gelatine, glue, adhesives, varnishes, lacquers and paints), paper, the plastic fibres, leather, rubber, ceramic industries, synthetic resins and plastics, and the textile fibres. This is the 'industrial' part, though—needless to say—many subjects of great industrial importance, such as wetting, spreading, detergency, emulsification, stabilization of emulsions and foams, flotation, commercial applications of adsorption, the linear polyesters, three-dimensional polymers, cellulose, starch, proteins, clay suspensions, fatty acid soaps, colloidal electrolytes, thixotropy, and the distortion of solids under stress, are discussed in the first part of the book. To complete this outline of the contents, the first part includes, besides those things already mentioned, long chapters dealing with suspensoids, amorphous solids, emulsoids, the electrochemical behaviour of colloids, gelation, emulsions and foams, and the crystalline and amorphous states. These chapters give the student an excellent account of the main facts and theories of colloid chemistry and physics, presented in a concise, lucid and accurate manner. They prepare him well for a good understanding of the industrial materials and processes which are dealt with later, though they may be read with great profit for their own sake and as a fundamental introduction to larger works and special monographs. At the end of every chapter of the book the authors give short but valuable bibliographies serving as guides to these special books and to important original papers and symposia. As every teacher and serious student knows, this is an important and valuable feature of a really good book.

The treatment is quantitative and accurate, though essentially non-mathematical. Colloid science in its present state does not require much mathematics, though when a little is required, as for example in the treatment of Brownian motion, sedimentation under gravity or centrifugal force, and electrophoresis, the authors do not hesitate to use it. The day is long gone by when the chemistry student intending to enter industry would fight shy of a differential coefficient or an integral, and nowadays he generally studies such things at school.

The chapters in the second half of the book dealing with the industrial materials and processes are so good that they may fairly be classed as unique. In the opinion of the reviewer, they constitute a new and in many respects pioneering model of how such matters should be handled. An ancient Greek philosopher, when some visitors were surprised to find him in his kitchen, is reputed to have said, "Here also are the gods". So we may say of these chapters, "Here also is science", for everywhere we find the complex materials and processes of industry set forth with such a clarity of scientific analysis that it is a joy to read about them. To quote a single example, the 50 pages dealing with rubber (natural and synthetic) can only be described as a superlative example of the fine art of science teaching, and are bound to demonstrate to the fortunate student who has access to this book that science has her home fully as much in the factory and the industrial laboratory as in the lecture rooms and laboratories of the academic campus.

It must not be thought, however, that the authors neglect the 'empirical' facts, for the matters under discussion are everywhere beautifully illustrated by diagrams, curves, tables of data, and (in certain cases) by reproductions of photographs; though the student is never weighed down by such a superabundance of illustration as would distract his mind from the correlating chain of scientific causal analysis. The authors do not write for the learned and experienced specialist. Their object, which is supremely well achieved, is so to teach the young student to apply creative thought and logical reasoning to the wealth of quantitatively ascertained and established facts that he will pass with courage and well-based hope from order to understanding and intelligent action.

Such excellence in method and presentation is no mere *tour de force*, but the ripe fruit of knowledge and experience. We can well believe the authors when they write in the preface, "This book is the outgrowth of personal practical experience which goes back over thirty years. It embodies the results of twenty-five years teaching the subject at the Massachusetts Institute of Technology. The text has been prepared entirely by members of the staff, all but one of whom have since gone into industry. Over this long period many professional associates have, through suggestions, discussion and information, made contributions of major value which are deeply appreciated."

The reviewer has little to cavil at. The following notes are mostly suggestions which the authors may perhaps consider worthy of some consideration in the preparation of the next edition:

(1) In connexion with the subject of colloidal electrolytes some more attention might be paid to soaps and to paraffin-chain salts in general (work of McBain and Hartley) and to aqueous solutions of alkali silicates (work of Harman). Hartley's little monograph on "Aqueous Solutions of Paraffin-chain Salts" (No. 367 of the *Actualités scientifiques et industrielles*, published by Hermann, Paris) might be included in the bibliography. Possibly also the Faraday Society Discussion on Colloidal Electrolytes (1934).

(2) "Suspensoids never form gels" (p. 169). Do not some suspensoids, for example, nickel (metal) and cuprous acetylide, form gels, or at least thixotropic geloids?

(3) "Failure of osmotic methods for determination of the molecular weights of proteins" (p. 159). What about the successful work of G. S. Adair?

(4) In connexion with the subject of thixotropy, references might be made to some of the numerous papers by Freundlich and his collaborators and also to his monograph on thixotropy (No. 267 of the *Actualités*, etc., published by Hermann, Paris).

(5) A section might be devoted to the colloidal chemistry of starch and starch pastes.

(6) Under textile fibres reference might be made to the excellent book of E. Valkó, entitled "Kolloidchemische Grundlagen der Textilveredlung" (Springer, Berlin, 1937).

(7) In the bibliography relating to suspensoids, reference might be made to the Utrecht Symposium on Hydrophobic Colloids (published by D. B. Centen, Amsterdam, 1937).

(8) Under "flotation" it would be well to refer to I. W. Wark's excellent "Principles of Flotation" (published by the Australasian Institute of Mining and Metallurgy, Melbourne, 1938).

(9) In the author index, N. K. Adam is indexed under "Adams".

(10) In the bibliography to Chapter 2, G. W. Scott Blair is referred to as "G. W. Scott". A corresponding correction is required in the author index (p. 521).

This book can be most strongly recommended to all students of chemistry (whether they intend to enter industry or not), and to their teachers as well. They will not fail to derive knowledge, satisfaction and inspiration from it. The authors are to be heartily congratulated on a fine and most valuable contribution to the advancement of science and industry.

F. G. DONNAN.

JUVENILE CRIME

Young Offenders

An Enquiry into Juvenile Delinquency. By A. M. Carr-Saunders, Hermann Mannheim, E. C. Rhodes. Pp. x+168. (Cambridge: At the University Press, 1942.) 7*s*. 6*d*. net.

BETWEEN 1928 and 1938 the number of males under sixteen found guilty in Great Britain of indictable offences approximately doubled. An increase in the number charged and found guilty does not necessarily imply an increase in the amount of crime. Nevertheless, in view of these somewhat startling figures, the Home Secretary determined to institute an investigation into the whole problem of juvenile delinquency. At a meeting convened at the Home Office early in 1938, it was decided to start with an inquiry in the London area; and its supervision was entrusted to the Director of the London School of Economics, Prof. A. M. Carr-Saunders. The procedure proposed was to collect, through the medium of the Probation Office and the Education Department of the London County Council, all available information relating to the first thousand cases brought before the juvenile courts in London after October 1, 1938. Later it was agreed to extend the inquiry to Manchester, Leeds, Sheffield, Hull, Nottingham and Cardiff. The particulars to be recorded related to such matters as the time, place and nature of the boy's offence, his attainments and conduct as assessed by the school, the number and nature of the jobs taken up after leaving school, and the characteristics of his home, his parents or guardians, and his relatives. It was also intended, after the social and scholastic conditions had been dealt with, to take up a supplementary study of the psychological aspects: this, however, was unfortunately prevented by the outbreak of the War.

The whole survey has been admirably planned; and both methods and results are described with care and lucidity. In the main the conclusions confirm those already reached in earlier investigations carried out in isolated areas on a much smaller scale. To the scientific reader the most interesting feature of the research will probably be the statistical technique adopted. In analysing the data the principle followed consists in what psychologists have called the method of 'progressive delimitation': it might be described as a form of multiple factor-analysis, starting with the factor that contributes most to the total variance, and working through other factors which are less and less important in order.

In an inquiry on this wide scale it would have been scarcely possible to obtain graded assessments. Consequently, a full correlational technique was out of the question. For the main characteristics the cases have simply been classified on a dichotomous or 'bipolar' principle with positive and negative categories. In juvenile delinquency one of the most important factors appears to be 'the structure of the family' from which the delinquent comes. Accordingly, the first step is to contrast families of 'normal structure' with 'broken' families. Then, concentrating upon the former group, the next step is to contrast those normal families in which the home 'atmosphere' is normal with those in which it is abnormal. The third step is to subdivide in much the same way the subgroup coming from homes where both the family 'structure' and the 'atmosphere' are normal. Thus, by continually selecting cases in which certain factors are relatively constant, it becomes possible to isolate in order the effects of different conditions in the child's environment.

As compared with most earlier investigations the present inquiry has two great merits: the first is the large number studied; the second, the use of a control group. As the writers point out, except for a single investigation carried out in the London area by the Council's psychologist, this latter safeguard has scarcely ever been adopted. Even in the present inquiry, practical difficulties were encountered; and the writers themselves feel somewhat doubtful how far they have been overcome. The chief weakness would seem to arise from the fact that the selection of the 'control-case' was left to the head-teacher, who was asked to name a law-abiding lad of about the same age "who could reasonably be regarded as a 'mate' to the delinquent case". It is conceivable that some of the difference ultimately found may simply reflect the head-teacher's view of what boys would be good representatives of the law-abiding majority in their own particular school.

The investigators conclude that, although the "figures are not easy to interpret, . . . it seems certain that there was some real increase in the amount of juvenile delinquency up to 1938". As regards causation they agree with earlier investigators that delinquency is due to a multiplicity of causes, and the combination of causes may differ widely from one case to another. The chief environmental factor appears to be the 'abnormal home', that is, a home in which either a normal 'structure' or a normal 'atmosphere' is lacking, where the parents are separated, or in a constant state of friction, or where the

discipline is harsh or over-indulgent. A second group of conditions may be classed under the head of "opportunity for mischief": 30 per cent of the sixteen-year-old delinquents were unemployed, and one third of the offences committed during the hours of darkness. Yet these are by no means the only factors, since—particularly perhaps during periods of stress or disturbance—normal boys from normal homes may occasionally succumb to what the writers call 'stray or chance' delinquency.

Although many problems are admittedly left unsolved, the publication of this carefully conducted research, demonstrating the unquestionable influence of social and domestic factors, is particularly opportune. Of late there has been an increasing tendency, particularly among medical writers, to revive the ancient view that 'crime is essentially a form of mental illness'. The present report throws the onus of proof on those who advocate the pathological hypothesis: it now becomes incumbent on them to support their view, not merely by impressions gleaned from the study of individual cases in the clinic or the consulting-room, but also by a statistical analysis of data collected with equal care. The present investigators suggest three main lines for future inquiries: first, further statistical studies of the various environmental factors, to be carried out, not spasmodically, but continuously or at regular intervals; secondly, an intensive study of the psychological aspects with particular reference to susceptible types; thirdly, a supplementary study of the relative efficacy of different methods of treatment. Only on the basis of cumulative scientific researches can practical measures be laid down.

CYRIL BURT.

THE AIRMAN'S LABORATORY

Weather

An Introductory Meteorology for Airmen. By W. G. Kendrew. (Oxford Air Training Manuals.) Pp. 96. (London: Oxford University Press, 1942.) 2s. net.

THE author of these hundred pages addresses himself to the airman student who comes fresh to meteorology and has little knowledge of physics. That is not an easy task—no good elementary textbook is—and great success has not been achieved in this instance. Nevertheless, the author's aim is sound: to present a limited factual survey of the physics of the troposphere, the medium in which the student will in the main be flying, and, so that the book shall be more than an exercise of memory, to attempt some correlation of the facts themselves. No mathematics is used in the process.

Atmospheric dynamics and thermodynamics are not, within the scope of this book, essentially difficult. But they are complex, and school laboratory experience is not easily extrapolated to a large three-dimensional domain in which air does not necessarily move from a region of high pressure to one of low pressure, nor is its readiness to turn upside down determined by an increase of density with height. It is therefore due to an author, so far as present knowledge and his self-imposed limits allow, to be particularly explicit on the conditions of Nature's experiments which he is describing. One could have expected greater clarity in many instances here. Thus a clear night atmosphere is a by no means ineffective blanket in checking loss of heat from the earth (about a quarter only of the earth's radiation is allowed to escape), though a layer of low cloud is certainly a more effective blanket; the absolute humidity of air which is heated does not in general remain constant; temperature inversions are essentially of two kinds, both in mode of formation and in effect, at the surface and in the free air, and the distinction is not clearly drawn.

There are excellent concise statements of air masses, pressure systems and the synoptic weather chart, and the author has nicely stressed the importance of the actual physical qualities of the air 'on the stage' rather than the label which has been attached to it. The new student of the subject should gain a good deal from the book, but will need to read further if his ideas are to be really coherent and if he is to get the best out of the meteorological advice which as an airman he is offered.

DEFECTS OF SPEECH

Speech and Voice

Their Evolution, Pathology and Therapy. By Dr. Leopold Stein. Pp. xii+233. (London: Methuen and Co., Ltd., 1942.) 15s. net.

IN this elegant and well-documented study, the author uses a life-time of clinical experience and a highly developed critical faculty when discussing the cognate work of others. As befits a member of the Tavistock Clinic, the only large body of consultative and practising psycho-therapists in Great Britain, the author sees in the development of speech in the individual a parallelism to the development of the body through a compressed re-capitulation of the evolutionary development of the species through the ages. Thus, from the very first id cries of the baby every further stage of speech control, as a method of communicating ideas, is but adding a further layer of psychological development on what is more primitive. Conversely, the major defects of speech, representing loss of such higher layers, such as aphasia, dyslalia, and stammering, are treated by conducting the patient through a vocal training largely based on the evolution of language, deduced by the comparative study of primitive languages and the natural efforts of an infant in endeavouring to make his wants understood; this, of course, in addition to any *ad hoc* psychological treatment.

In the author's comparatively condensed treatment of his subject he is exceptionally clear in his definitions and meanings of the technical terms he uses; in some instances he seems to overstress derivations of words, because we know that verbal meanings tend to change as their subjects develop. But vocal *chords* is surely an archaic spelling.

Ostensibly for speech therapists, nevertheless the present text has considerable use for the general scientific reader, especially as the author deals with related phenomena, such as organic troubles, breaking of the voice, laryngectomy and speaking with the aid of air from the stomach, and vocal exercises. The main feature is the psychological approach to speech defects, and the new hope given to sufferers by modern methods of treatment.

L. E. C. HUGHES.

THEORETICAL PHYSICS IN THE U.S.S.R. DURING THE PAST TWENTY-FIVE YEARS

By PROF. DMITRY IVANENKO

THE advances of physics have been especially significant during the last quarter of a century; modern theoretical physics, in particular, is a child of this period. Our concern, in this article, is mostly quantum mechanics of recent times. The papers of 1932–38 mentioned in this article have been published in the *Physikalische Zeitschrift der Soujetunion*, and the papers dating 1933–34 in the *Journal of Physics* (issued by the Academy of Sciences of the U.S.S.R.).

Relativity. Among the few papers on relativity theory a prominent place is due to the discovery made by the late Prof. Friedman of the non-static solution of Einstein's equations of gravitation (1922). This work has influenced the development of relativistic cosmology which has followed. We may also mention the recent memoir by Fock (1939) on the approximate solutions of the gravitational equations for bodies of finite extension, from which the equations for motion were automatically derived. Fock's calculations are much simpler than those of Einstein, Hoffman and Infeld for point masses.

General Quantum Mechanics. Mention is first of all due to Fock's approximate method, now widely used, which generalizes that of Hartree. To the same author we owe also an exhaustive treatment of quantum electrodynamics as well as a simple quantum derivation of Coulomb's law (together with Dirac and Podolsky). There is no need to dwell upon earlier studies by Fock in the relativistic generalization of Schrödinger's equations or on Frenkel's correction (Thomas-Frenkel's term) for the electron motion, as this is now discussed in text-books. It will be recalled that we owe to Frenkel the classical theory of a spinning particle (1926).

Of general interest is the idea of 'individual' error in measuring co-ordinates in the relativistic quantum mechanics. This idea, as contrasted with the common conjugate errors, was suggested by V. Ambarzumian and D. Ivanenko and developed especially by Schrödinger. 'Individual' errors for electromagnetic fields were discussed by Jordan and Fock and by L. Landau and Peierls.

Dirac's Theory. A thorough analysis of Dirac's equation has been undertaken by Ivanenko (introduction of hypercomplex numbers), by Fock (formulation by means of proper time) and others. Of particular importance is the theory of parallel displacement of Dirac's wave function (Fock and Ivanenko, 1929) by means of which Dirac's equation was immediately brought into a general relativistic form. This study was extended by Weyl, Schrödinger, Dirac and Pauli.

Meson Theory. Proca's equations were quantized by Ivanenko, Durandin and Ershov, who showed their inapplicability to electrons, but were recommended by Tukawa, Heitler and Kemmer as the best device for the description of mesons. Purely classical mesodynamics, taking account of damping, in particular, were treated by Ivanenko and Sokolov concurrently with Bhabha. The difficulties here encountered, such as the unlimited growth of cross-sections upon scattering of meson nuclei (Sokolov), the impossibility of stable orbits for a meson revolving around a nucleus (I. Tamm), etc., are all connected with the dipoleness of the meson as manifested both in electromagnetic and nuclear effects (Ivanenko and Sokolov). Hence the results of Smorodinsky and Landau (Compton effect on the meson) and those of Ivanenko, Sokolov and Rosman (population of a vacuum by meson pairs). We consider it as one of the most interesting results of the quantum theory of mesons that Sokolov (1941) has suggested a quantum account of damping which decreases the growth of cross-sections and thus eliminates a serious difficulty.

Atomic Nucleus. The modern model of the atomic nucleus composed of only heavy elementary particles suggested by Ivanenko (1943) raises the question as to new specific nuclear forces. The first model of nuclear forces realized by electrons and neutrinos was developed by Tamm and Ivanenko (1934). This is still a specimen for every model of forces (compare, for example, the prediction of non-central forces by Tamm, although as shown later on by Tukawa the principal part is played here by meson forces).

The statistical theory of the nucleus was extended by Frenkel (nuclear temperature, electrocapillary vibrations, spectroscopy and fission) and by Landau (distribution of energy-levels). A detailed analysis of the chain reaction of the fission of uranium was carried out by Khariton and Seldovich. Migdal has analysed the tracks of the fission products.

Cosmic Rays. The complex equations of the shower theory of Heitler and Bhabha and of Oppenheimer and Carlson were first integrated in a concise form by Ivanenko and Sokolov (1938) with the aid of Mellin's transformations already mentioned in a previous publication by Landau. Further refinement was brought about by Tamm and Belenky, taking due account of the ionization losses.

Statistics and General Theory of Solids and Fluids. The general statistical theory of a continuum was given by Leontovich, Mandelstamm, Leontovich; and their associates (Shaposhnikov, Vladimirsky, Galanin) have treated by classical means the study of various cases of sound absorption in fluids, strong and weak electrolytes, emulsions and suspensions. Much work was done on solids by Frenkel, who has just completed a monograph on fluids. Suffice it to mention his studies of excitation waves and some recent studies in plasticity (in collaboration with Kontorova, 1940), on the temperature dependence of surface tension (1940), and on the mechanical properties of amorphous bodies. We owe to Tamm an interesting consideration of the surface-levels of electrons in crystals. Landau has developed a very general fundamental theory of phase transitions 'of the second kind' connected with a jump in symmetry (1937). This study was extended by E. Lifshiz (1941).

Landau and his associates, Akhieser and Pomeranchuk, treated sound absorption in solids by means of quantum mechanics. According to the recent hypothesis advanced by Landau, superfluid helium II is considered to be in a state of potential quantized motion which lies lower than the state of vortex motion.

Quantum Theory of Metals and Semi-Conductors. In this connexion we may mention, first of all, the pioneer work, at Joffe's Physico-Technical Institute, of Frenkel on electronic and 'hole' conductivity, on rectification, etc. It will be noted that Frenkel was the first to suggest the ingenious idea of the degenerate gas in stars. Some valuable work on semi-conductors has been done by Blokhinzev and Davydov.

An interesting result of Landau's work is the proof of diamagnetism of the quantum electron gas. It was shown by Landau that in a transient state superconductors are composed of alternating common and superconducting regions.

As to the quantum theory of metals, Tamm and Blokhinzev have ascertained the role of image forces in the escape of electrons, and Tamm has discussed in detail the photo-effect from metals.

Many properties of ferromagnetic bodies have been accounted for by I. Akulov's anisotropy law. The quantum theory of ferromagnetic alloys, magnetostriction, etc., was developed by Vonsovsky (1940). The role of anharmonic effects in conductivity was discussed by A. Smirnov. A noteworthy place is occupied by Granovsky's and Vlasova's work on plasma.

Optics. Numerous detailed computations of spectra were carried out in the Leningrad Optical Institute by means of Fock's approximate methods. Much work was done on molecular spectra by Eliashevich and Stepanov. The modern theory of phosphorescence as a series of bimolecular reactions was developed by Blokhinzev (1937). Mandelstam and Leontovich extended the classical, and Tamm the quantum, theory of the Raman effect in solids. Leontovich studied the Rayleigh scattering in anisotropic fluids.

Among the ideas of Mandelstam's school mention may be made of an ingenious explanation by Tamm and Frank of the new kind of radiation, discovered by Cherenkov in Vavilov's laboratory, as due to electrons moving at a velocity exceeding the phase velocity of light in the given medium.

It is not possible to discuss, within the confines of the present article, various problems of classical electrodynamics and their technical application as pursued by Mandelstam and Papalexi with their associates Rytov, Filipov and others. Mention may, however, be made of the theory of non-linear vibrations, which has had some interesting practical implications (compare the monograph by Andrianov and Khaikin).

The above is a concise outline of the development of theoretical physics in the U.S.S.R. We may point with satisfaction to the existence of several scientific schools, and of a great number of young men of science who have already done valuable research. Work on theoretical physics carried out in the U.S.S.R. during the past twenty to twenty-five years has played a noteworthy part in modern developments of the subject.

TERMINOLOGY IN THE GEOLOGICAL SCIENCES

By DR. R. H. RASTALL

FOR many years past and especially of late in publications and conferences dealing with war-time problems and post-war planning, much stress has been laid on the unfortunate fact that in Great Britain the governing classes and the general public are not geologically minded. This is not the place to discuss in detail the disastrous neglect of economic and applied geology and mineralogy in some of the universities of Great Britain, but it is proposed rather to point out some ways in which the study and appreciation of geology by ordinary non-specialist educated people is rendered unnecessarily difficult.

One of the most glaring of these obstacles is by no means confined to geology, but is common to all biological sciences, namely, the volume and complication of the nomenclature now current. To the ordinary person, these sciences present themselves mainly as masses of outlandish and arbitrary names, which seem to have no sense or reason about them. Now there can be no doubt that of late years this has got much worse in geological studies, owing to the superabundance of minute detail now prevailing both in stratigraphy and palæontology. Fortunately, in petrology there has recently been a definite reaction against the multiplication of unnecessary names, although even this has not received all the support that might be wished.

By far the greater part of the trouble arises from the activities of the palæontologists. It is now a common saying and only too true that a field worker cannot name his own fossils: they all have to be sent to a specialist—a most unfortunate state of affairs, and a very unfair handicap on the field-worker. It remains to consider what are the real causes of this situation. First of all, there is one inevitable reason: the extension of knowledge, against which nothing can be said. But the real crux is the way in which that extension of knowledge is employed. Now, unfortunately, the whole tendency has been and is to make things infinitely more complicated, instead of any attempt at simplification. It is commonly understood that modern palæontology is supposed to be founded on evolutionary lines, but it really seems that the present tendency to hair-splitting distinctions and infinite multiplication of new names is exactly contrary to the true principle of evolution. All the emphasis is on differences instead of resemblances: dividing instead of grouping. Many such distinctions correspond to extremely minute differences. Hence natural relationships are concealed, not emphasized. This is not the spirit of Darwin and Wallace.

In palæontology this tendency finds expression in the institution of new genera. In the case of new and hitherto undescribed fossils this is, of course, necessary, but the reference is here to the infinite sub-division of old and well-established genera. It is scarcely too much to say that almost no fossils known in the times of William Smith, Lyell, Buckland, Sedgwick and Murchison still retain the same names, and it might almost be said of the era of Lapworth and Geikie. Such well-known names as Terebratula, Rhynchonella, Ostrea and Pecten have practically disappeared from the literature. The graptolites have probably suffered less than any other group in this way, probably because the authorities on this group happen to have been out-door geologists. One such alteration in this group may perhaps be mentioned: the abandonment of the earlier name of Nemagraptus, which led too obviously to undergraduate attempts at humour (but I see no graptus).

The last sentence but one really touches the root of the matter. All these modern developments are mainly due to museum specialists; people with the Civil Service mind, who spend all their time indoors, surrounded by mountains of monographs instead of mountains of rocks, and appear to delight in making everything as complicated as possible. This is not evolutionary progress, but obscurantism, and if natural science in any form is ever to become a

serious part of general education it will have to be amended.

Another factor, admittedly of less importance but still real, is the strict and indiscriminate application of the laws of priority, whereby old and universally known names are displaced by others discovered by antiquarian grubbing in forgotten publications. The motto here should be "let sleeping dogs lie", or "quieta non movere".

One result of all this is that an ordinary geologist who learnt his elementary work, say, forty or fifty years ago, when reading a modern stratigraphical paper often has a very vague idea of what it is all about, unless he happens to be a specialist in that particular subject. Sometimes the specific name may give him a clue to the identity of a fossil assigned to some genus of which he has never heard. Otherwise he may vainly hunt through much literature for an explanation.

This leads on naturally to another important side of the subject, namely, the effect of all this on the general view of geology taken by less specialized and especially by amateur readers; what may well be called the popular view. This can be simply summed up in a single phrase. *Popular geology is being killed by pedantry*, and even in schools and universities the subject is rendered so unattractive that few students select it. The falling off in the number of students of geology in many universities is notorious, but the special point to be made here is that this falling off is not the fault of the teachers, but of the state to which the science itself has been reduced by people who are not teachers, and moreover are not sufficiently men of the world to realize the disastrous effect on the science and its practical applications in the future of their well-meaning but wholly misdirected efforts.

Another instance may be mentioned as affecting what used to be a favourite field for amateurs, namely, the incessant introduction of new and uncouth names for minute sub-divisions of prehistoric cultures. This is usually considered to be part of geology, but it is really prehistoric archæology, and modern developments have made it quite unsuitable for inclusion in elementary teaching courses, owing to the multiplicity of detail. Students who take geology for any purpose beyond the mere attainment of a degree cannot afford to spend the necessary time on this kind of thing.

It is often said in academic circles that the study of parts of a scientific subject having no practical applications is an excellent preparation for something else later on; this sounds remarkably like the usual argument for a classical education. It is, of course, true that specialization can and often does begin too soon, but surely elementary education should be wide, not deep.

Another deterrent to the popularization of geology, so obvious as to make detailed discussion unnecessary, is the enormous number of zones and sub-zones now recognized in several systems; as, for example, the ammonites in the Jurassic and the graptolites in the Silurian. Furthermore, the names now applied to the ammonites in particular can only be described as appalling and quite sufficient in themselves to choke off any nascent interest in the subject, either in students or amateurs.

Finally, reference may be made to a complication for which there is an easy remedy. That is the practice of invariably quoting after the name of a fossil the authority by whom it was first described, even in supposedly popular or semi-popular writings. It is, of course, obvious that this must often be done in technical discussions by specialists, but it is submitted that it is entirely out of place in texts intended for students or amateurs. The effect on students is most depressing. They conclude that they are expected to learn three words for the name of every fossil, and also to remember the meaning of the abbreviation which often represents the name of the authority. Then there is the further complication of the brackets in which the name of the authority is often enclosed, which means that the said authority did not call the fossil by the name there printed, but something quite different. Incidentally, owing to a reason before discussed, nearly all names now have these brackets. The effect on amateurs is equally depressing.

Fortunately, petrology and mineralogy get on very well without such a system, although in point of fact in petrology there would probably be more excuse for it, since many rock-names have been used in varying senses; for example, the very common name *dolerite*. But it may well be considered what petrological literature would be like if one was compelled to write "basalt Pliny" or "granite God knows who" every time. For mineralogy the imagination reels at the prospect. Cannot palæontologists be induced to compare their own proceedings with this?

The state of affairs here sketched must obviously be a passing phase, and there should eventually be found some means of simplification. If not, as a result of forty years experience of geology in all its branches, especially in teaching, it can only be said that the prospect is dark indeed.

FREEDOM IN SCIENCE

By Dr. H. LOWERY

WAR-TIME necessity has required that science shall be planned in its applications to the problems of national defence, food production, and other matters connected therewith. Indeed, the success or failure of a nation at war is easily seen to depend mainly upon how well it is able to utilize its scientific knowledge.

We must be careful, however, to distinguish between science on one hand and the applications of science on the other, a distinction that may be represented by the difference between science and technology. Science is concerned with the disinterested and dispassionate search for truth, and the man of science at work cannot see whither the road he travels will lead him. He must on occasion be prepared to follow what looks like a by-path, and it is vitally important that he should be free to do so if he chooses to leave his main road. A characteristic feature of technology, however, is that it is concerned with more or less clearly defined ends; the technologist sets out to achieve a definite object, improving a manufacturing process, carrying out to its logical conclusion some practical possibilities inherent in some general scientific principle, as, for example, when he sets out to design an electric motor for a particular purpose. While it is true that the technologist in his endeavour to achieve his goal may discover interesting new facts and may actually follow

up some of these, nevertheless as a technologist he must carry out his original intention if he is to be successful at his job. Many of the larger research associations are sufficiently enlightened to recognize that their technologists may come across new possibilities, and are prepared to give their research workers their head, as a result of which countless advances in knowledge have been made in industrial laboratories, especially in the United States, which cannot be described other than as 'pure science'. On the other hand, not a little work of a distinctly technological nature has emerged from the universities.

No one will deny that technology is important in our life. Not even the most ardent scientific man would want to ban the practical achievements of the technologist. Unfortunately, the uncontrolled applications of the objective sciences as against the almost complete neglect of the applications of the social sciences have brought us perilously near the abyss of collapse of our civilization. As a result, there is a widespread belief, resting on a fallacy, that a complete planning of scientific investigation from above, presumably by the State, is the only way to our material salvation. The fallacy lies in the fact that scientific research as distinct from technological research cannot be planned. The man of science cannot see the end of his investigations and must be content to have faith and follow where truth leads; the man of science, unlike the technologist, cannot be judged by results, he cannot work to a time-table. His greatest moments of inspiration and insight may, and often do, occur when to the onlooker he is 'off duty'. Many of his most brilliant successes are the result of chance occurrences and of his freedom to take advantage of accidental happenings and observations, with the consequent need for change of direction in his work —a diversion which under rigid planning from above would not be permitted.

There is one important implication in planning which is often overlooked by planners, and that is that the more life is planned the less freedom there is for the individual, a fact which has recently been stressed by the Archbishop of Canterbury. If science were completely planned, the research worker would no longer be independent or able to choose his own line of investigation. He would have to work continuously according to some hypothetical formula or even political slogan, always being prepared to subordinate his intuitions, his conscience and his intellect to the dictates of the superimposed policy. We cannot contemplate any scientific man, not to speak of a Faraday, a Newton or a Maxwell, doing creative work under these conditions.

In a recent lecture to the London and Home Counties' Branch of the Institute of Physics, Dr. J. R. Baker, of the Department of Zoology of the University of Oxford, gave a stimulating account of the *desiderata* in the conditions under which the man of science should work, emphasizing in particular the importance of free choice in following up any new suggestion or chance occurrence in his investigations. Dr. Baker did not deny that the prime service of the man of science is to make his maximum contribution to the community through his own particular sphere of activity, which is akin to that of the artist and the musician. Without saying so explicitly, he did nevertheless suggest that the man of science working in the realm of ideas is akin to the student of æsthetics, a field in which the mere notion of planning is ludicrous. The guiding principle behind Dr. Baker's remarks was simply that planning of the work of the man of science will defeat its own ends through strangulation of the very spirit of science. He made it quite clear that he did not see any opposition between science and technology.

Indeed, in the subsequent discussion on Dr. Baker's lecture, it was easily seen that the technologists were in broad agreement with him on the need for freedom of the scientific worker. It was clear, however, that science is being attacked from within. Certain men of science, apparently misled by the undoubted need for the close linking of the objective sciences and the social sciences, have quite wrongly come to the conclusion that this link should take the form of *complete* planning of all science. Other motives, possibly of a purely political nature, seem also to be involved. It must not be forgotten, however, that the scientist, as a scientist, is not concerned with politics or even with applications, and therefore controls of any kind and the emotional associations which are invariably aroused by political action are inimical to his scientific advance.

During the vigorous and lengthy discussion which followed Dr. Baker's lecture, many aspects of scientific work were raised, a few only of which can be chosen for mention here. One speaker pointed out that in any country only a small number of people will either have the ability or resources to spend their lifetime in purely scientific research. Most prospective men of science are hampered by the need to make a living. They must therefore work in conjunction with research associations and other organizations which are primarily concerned with technological applications. It was pointed out, however, that even in associations of this kind, there is room for the scientifically inclined investigator to fulfil his hopes and ambitions and so follow up chance discoveries without concern as to any material end.

In this part of the discussion some members of the audience were worried as to the distinction between pure science and applied science. Rigorous definitions are impossible, but Dr. Baker suggested as the chief distinguishing characteristic the fact that scientific results are of permanent value, whereas technological results are of ephemeral value, being out-dated by further technological achievements in the same field —he quoted, for example, the out-dating of the musical box on the advent of the gramophone.

Another speaker referred to the ample resources for scientific research provided in the U.S.S.R. and emphasized that scientific work must have due relation to the needs of the country. Another point made was that the task of the man of science is to lead the people, and therefore he cannot remain aloof from political and social questions.

A scientific worker who had had experience both in industry and in university research emphasized that no gap really exists between pure and applied science, but pointed out that, on the whole, British industry has in general failed to realize how best to utilize the services of the scientific man. It has expected final results too soon and has not been bold enough to pin its faith on the activities of the scientifically trained man. He pleaded for a more adventurous spirit in the attitude of British industry towards science, and hoped that industry would give greater support to scientific research after the War than it has done in the past, as there can be no doubt that the development of new industries and the building up of a virile export trade cannot be accomplished without using to the full the contributions that men of science can make to the community.

Throughout the discussion reference was frequently made to the need for the precise definition of terms, particularly the term 'truth' in the expression that 'science is concerned with the search for truth'. As one speaker aptly expressed the problem in reference to X-rays: Which is to be regarded as truth, (*a*) the fact that we can measure the wave-length of X-rays, or (*b*) the fact that we can use X-rays for therapeutic purposes? Again in regard to chloroform, (*a*) we know the chemical structure of the substance, and (*b*) we can employ it in order to alleviate pain. In each case are not the two aspects of our knowledge intimately bound together? This speaker concluded that we are unable to insist on the freedom of pure science.

From what has been said above, it will be clear that Dr. Baker opened up an important subject for consideration in war-time when everyone is deeply concerned with what we are to do with our lives both as individuals and as members of the community. His problems are of more than mere academical interest, and an outside observer at the discussion could not fail to be impressed with the sincere desire of the many scientific workers present to make their due contribution, in whatever form may be most appropriate, to the best needs of the community.

THE MALACOLOGICAL SOCIETY OF LONDON, 1893-1943

ON February 27, 1893, W. H. Hudleston, F.R.S., then president of the Geological Society, presided over a meeting at which the Malacological Society of London was inaugurated and the first council elected with Dr. Henry Woodward, F.R.S., as first president. On February 27 last the Society commemorated its jubilee in the rooms of the Linnean Society at its 415th meeting, with the twentieth president, Dr. A. T. Hopwood, in the chair.

Of the original seventy members Mr. E. R. Sykes (president 1904–7) and Mr. J. R. le B. Tomlin (president 1916–19) sent greetings, and Mr. A. S. Kennard (president 1922–25) gave an account of the Society's early history. Founded for the study of Mollusca, it owed much of its success to the enthusiasm of its first secretary, E. R. Sykes, and to the assistance of E. A. Smith, who was in charge of the British Museum Mollusca from 1871 until 1913. The Society early attracted notice in other countries and among the fifty-one corresponding members of its first year were included: W. H. Dall (1845–1927), who studied under Agassiz; C. Hedley (1862–1926), R. Tate (1840–1901), Joseph C. Verco (1851–1933), in Australia; F. W. Hutton (1836–1905), H. Suter (1841–1918) in New Zealand; H. C. Burnup (1852–1928), of the Natal Museum; Ph. Dautzenberg (1849–1935), of Paris, and the Marchese di Monterosato (1841–1927), of Palermo, two of the greatest private collectors; P. Fischer (1835–1893), best known of that family of many malacologists; M. Cossmann (1850–1924), who despite the heavy duties of chief technical officer of the Chemin de fer du Nord wrote a revision of the Paris Basin mollusca; A. Brot (1821–1896), of Geneva; S. Brusina (1845–1898), of Agram University; W. Kobelt (1840–1916); E. von Martens (1831–1904), first, and for twenty-one years, recorder of the molluscan section of the *Zoological Record*. The keen interest of H. A. Pilsbry, elected in 1894, brought in more American members, including C. W. Johnson (1863–1932), co-editor with him of the *Nautilus*. The cosmopolitan interest of the Society is marked by the fact that from 1908 until 1939 the number of corresponding members exceeded that of ordinary members. Nevertheless, the pulse of the Society has always centred in the meetings in London, which have mostly been held in the Linnean Society's rooms, though for a year (1928–29) the Society met in University College, and since 1939 many meetings have been held in the British Museum (Natural History).

The Society has always had good service from its officers, some of whom have served for long periods: J. H. Ponsonby was treasurer from 1900 until 1916; the present treasurer, Dr. R. L. Cox, was elected in 1926 and since 1939 has also served as acting secretary *vice* Captain G. I. Crawford, absent on war service; A. E. Salisbury (president 1933–36) served as secretary from 1919 until 1933; B. B. Woodward (president 1907–10) and E. A. Smith (president 1901–04) between them edited the *Proceedings* from 1893 until 1925, the former for periods of eleven and nine years and the latter for twelve years.

One object in founding the Society was to bring palæontologists into touch with workers on recent Mollusca. A similar motive brought into being the Société malacologique de Belgique, the *Annales* of which contain far more fossil than recent work. Fossil Mollusca figure largely in the Society's *Proceedings*; one may instance the many papers by R. Bullen Newton (president 1910–13) and by G. C. Crick on cephalopods, notably two on the pro-ostracum and arms of belemnites[1]. More recently, a series of papers from 1925 onwards by A. Wrigley on English Eocene and Oligocene gastropods illustrates the value of co-ordinating recent and fossil studies, while Dr. L. R. Cox has contributed many papers on Tertiary and Mesozoic shells, notably a study of the rudist genus Trechmanella[2]. Much of the work on British Pliocene and post-Pliocene non-marine Mollusca by A. S. Kennard and B. B. Woodward appeared in vols. 2–24 of the *Proceedings*. The close though informal association of the Society with the British Museum indicated by the above names was remarked upon by Dr. A. T. Hopwood in his presidential address to the jubilee meeting, and emphasized by Dr. C. Forster-Cooper in his reply.

Mr. R. Winckworth (president 1939–42) exhibited the *Malacological and Conchological Magazine*, produced by G. B. Sowerby in 1838 and 1839 with the object of inducing "noblemen and gentlemen" to found a society: he also gave some statistics of the *Proceedings of the Malacological Society*, now in its twenty-fifth volume and totalling 8,054 pages.

Anatomy very properly holds an important place in the *Proceedings*. The first paper read and published was on the anatomy of Paryphanta by H. H. Godwin-Austen (president 1897–99), who contributed so largely to our knowledge of Indian land Mollusca. M. F. Woodward, son of H. Woodward, had already written some important anatomical papers before his death in an accident at Ballynakill at the age of thirty-six: his most important work, that on Neurotomaria, was published elsewhere[3]. S. Pace, R. H. Burne, H. A. Pilsbry, H. Watson, N. H. Odhner, H. H. Bloomer and many others have added to this subject in the *Proceedings*, the last important paper being one by K. M. White on the pericardium and

pericardial gland in lamellibranchs[4]. The radula has naturally received much attention, especially from A. H. Cooke (president 1913–16) and A. J. Peile (president 1925–27). Molluscan fæces, a subject initiated by H. B. Moore, which yielded valuable results in systematics as well as in the study of submarine deposits, form the subject of a survey by him twelve years ago[5].

Many pages naturally are devoted to the description of new forms, such as the papers on British Museum material by E. A. Smith and the long series of papers by J. C. Melvill (president 1929) on shells from the Persian Gulf and Gulf of Oman dredged during 1890–1914 by Captain F. W. Townsend, who contributed his own reminiscences on collecting[6].

On the British non-marine Mollusca there are at least three important systematic monographs, that of A. S. Kennard, A. E. Salisbury and B. B. Woodward on Unionidæ[7], of H. E. Quick on Succineæ[8] and A. E. Ellis on Pisidium[9]. A. E. Boycott, the most revered of presidents (1927–29), and that great naturalist, C. Oldham, have given papers on ecology and genetics. Boycott's great work on the inheritance of sinistrality in Limnæa involving a million individuals was published by the Royal Society[10]; a subsidiary investigation on abnormal forms[11] figures *inter alia* a snail so equally poised between dextral and sinistral that its shell was a simple cone.

The size of the *Proceedings* does not often permit long papers. There are, however, some catalogues for which the Society has waived its usual practice, that of Columbellidæ[12] by S. Pace, of Marginellidæ[13] and of Conus[14], both by J. R. le B. Tomlin, and the revision of British nudibranchs by T. Iredale and C. H. O'Donoghue[15]. Much of F. A. Schilder's work on cowries was published by the Society, including the prodrome of a monograph of the Cypræidæ[16], "perhaps the first attempt to apply on a large scale to marine animals . . . methods of geographical delimitation of races"[17].

C. D. Sherborn's work on the "Index Animalium" directed the attention of naturalists to the importance of the bibliography of natural history. From 1901 onwards many bibliographical papers appear, the last being one by A. S. Kennard on the *Histoire* and *Prodrome* of Férussac[18]. The subject now has its own society and journal.

Exhibits have always been an interesting feature at the meetings and their records are often of interest; for example, W. G. Ridewood's exhibit of Phœnicurus[19], a genus which proves to be based on the cerata of a nudibranch. A year after Röntgen's discovery in 1895 of X-rays, a series of 'skiagraphs' of shells and living molluscs was exhibited[20]; the published plate of a nautilus must be counted an incunabulum of X-ray photography. Recently X-rays have been used to confirm the systematic relations of the rare shell Thatcheria[21].

At the jubilee meeting Prof. C. M. Yonge surveyed fifty years' work on functional anatomy, referring especially to the study of the molluscan gill, ciliary feeding, musculature, innervation.

Mr. A. Blok gave an account of shells and ornament, accompanied by a big range of exhibits from savage ornaments to modern industry, touching on ethnological and artistic aspects. Art at its lowest was seen in some of the Victorian 'horrors' and 'rubbish for tourists', while the highest level was shown in some of the cameos exhibited: the best known cameo artist was Benedetto Pistrucci, who also designed the George and dragon of our gold mintage.

Dr. L. R. Cox concluded the jubilee addresses with a review of fifty years of molluscan palæontology.

Honorary membership was instituted in 1921 when Dr. Woodward, the first president, Dr. Paul Pelseneer and Dr. C. D. Sherborn were elected. Since then, apart from previous members of the Society, J. W. Taylor, founder of the *Journal of Conchology* and of the Conchological Society, Prof. D. M. S. Watson and Sir D'Arcy Thompson have been added. Dr. H. A. Pilsbry, who recently celebrated his eightieth birthday, was elected an honorary member at the jubilee meeting.

In 1926 Mr. H. McClelland generously presented every member of the Society with a general index to the fifteen volumes of *Proceedings* and sixteen volumes of the *Journal of Conchology*, which he had prepared and published. The history of the Conchological Society has been recorded by Dr. J. W. Jackson[22]. Percy Edward Radley (1861–1927), a keen amateur of conchology and microscopy, bequeathed his library to the Society. This is kept in the library of University College, London.

In France, malacology has been represented chiefly by the *Journal de Conchyliologie*, founded by S. Petit de la Saussaye in 1850 and since 1860 associated with the Fischer family. In 1935 the direction of the *Journal* organized a *Réunion amicale* of conchologists, malacologists and palæontologists, at which Mr. A. Blok represented the Society. It was resolved to hold triennial meetings in Paris, Brussels and London, but subsequent events have prevented the fulfilment of this plan, which it is hoped will be revived after the War.

[1] *Proc. Malac. Soc.*, **2**, 117 (1896) and **7**, 269 (1907).
[2] *Proc. Malac. Soc.*, **21**, 42 (1934).
[3] *Quar. J. Micro. Sci.*, **44**, 215 (1901).
[4] Reviewed in NATURE, **150**, 771 (1942).
[5] *Proc. Malac. Soc.*, **19**, 281 (1931).
[6] *Proc. Malac. Soc.*, **18**, 118 (1928).
[7] *Proc. Malac. Soc.*, **16**, 267 (1925) and **17**, 191 (1927).
[8] *Proc. Malac. Soc.*, **20**, 295 (1933) and **21**, 96 (1934).
[9] *Proc. Malac. Soc.*, **24**, 44 (1940).
[10] Boycott, Diver, Garstang, Hardy and Turner, *Phil. Trans.*, B, 219, 51 (1930).
[11] *Proc. Malac. Soc.*, **19**, 141 (1930).
[12] *Proc. Malac. Soc.*, **5**, 36 (1902).
[13] *Proc. Malac. Soc.*, **12**, 242 (1917) and **13**, 41 (1918).
[14] *Proc. Malac. Soc.*, **22**, 205 (1937).
[15] *Proc. Malac. Soc.*, **15**, 195 (1923).
[16] *Proc. Malac. Soc.*, **23**, 119 (1938–39).
[17] NATURE, **144**, 642 (1939).
[18] *Proc. Malac. Soc.*, **25**, 12 and 105 (1942).
[19] *Proc. Malac. Soc.*, **8**, 121 (1908).
[20] *Proc. Malac. Soc.*, **2**, pl. 15, 179, 205 (1897).
[21] Eales, *Proc. Malac. Soc.*, **23**, 15 (1938).
[22] *J. Conchol.*, **18**, 65 (1927).

OBITUARIES

Dr. Leopold Frommer

DR. LEOPOLD FROMMER, of High Duty Alloys, Ltd., died after an operation on January 27, at the age of fifty. He was born of Polish parents and obtained his diploma in mechanical engineering at the Technical University of Berlin (Charlottenburg).

I first met Dr. Frommer in 1929, when he was working under Prof. M. Polanyi at the Kaiser Wilhelm Institut für Physikalische und Elektrochemie, in Dahlem, Berlin. He had just given up what promised to be a very successful industrial engineering career in order to take up fundamental research on the study of chemical kinetics. My interest was aroused, however, by his great knowledge of the pressure die-casting technique and his ability to apply funda-

mental engineering and physical principles to this highly commercialized process. For some time I had been thinking out ways of applying the pure scientist to technical problems, and in Frommer I found a man who in himself bridged the gap between the two, being that rare combination of a really practical engineer and a very competent scientific man.

In 1934, when Dr. Frommer was forced to give up his work at the Kaiser Wilhelm Institut, he came to England. Having completed his well-known book, "Handbuch der Spritzgusstechnik", he no longer retained any great interest in die-casting and was bent on a career of scientific research. Some time before, I had instituted in the High Duty Alloys research laboratories an investigation by means of X-ray crystallography into the determination of internal stresses in light-alloy components, the long-range objective of which was to enable us to control the manufacturing conditions which were responsible for these stresses. I offered to put Dr. Frommer in charge of this work and he readily accepted, seeing that this was a research problem after his own heart. He got down to work on the development of new experimental methods with extraordinary enthusiasm, and shortly afterwards undertook the additional tasks of developing spectrographic and colorimetric methods for routine analysis.

Dr. Frommer quickly organized the necessary departments in the laboratories and in two years had handed over spectrographic and colorimetric analysis for routine testing purposes. His main interest and greatest achievement were still, however, in the work on X-ray crystallography. He solved the problem of applying the technique to the measurement of internal stresses in aluminium and magnesium alloys, and designed some remarkable pieces of apparatus for applying these measurements to the largest aircraft components. The results he achieved were of real practical value and gave us much clearer insight into the formation of these stresses. Some of his work has been published and a great deal more will be published as soon as arrangements are complete. I believe that when all his results are known, he will be acknowledged to have added greatly to our knowledge of physical metallurgy.

In 1939 he was given the task of applying the technique of the measurement of internal friction of metals to technical problems, and here again found a research item which gave full rein to his peculiar talents. At the time of his death, he had evolved a technique incorporating many novel features for carrying out these measurements.

Dr. Frommer was a prodigious worker who never spared himself even when in ill-health. He was a most resourceful experimenter who brought a sound knowledge of mechanical engineering to aid him in his fundamental studies. He had an extraordinary capacity for rapidly assimilating and applying all the published information on any new problem which confronted him. His impatient and relentless pursuit of complete mastery of the many problems encountered in his researches made him grudge the time taken in writing reports, and in spite of repeated urging, the preparation of his results for publication lagged far behind his actual accomplishments and so, tragically enough, he was not spared to present many of his own most important discoveries. Thanks, however, to his admirable organizing abilities and planning, the departments which he built up will be able to carry on smoothly with the work which he initiated.

His untimely end at the early age of fifty is a great loss, both to pure physical science and to industrial research, and his many scientific friends and colleagues will feel a deep sense of loss at the passing of this able man, who at once possessed the highest qualities as a scientific worker and as an engineer.

W. C. DEVEREUX.

NEWS and VIEWS

University of Birmingham

IN his report to the Council, presented to the annual meeting of the Court of Governors, the Vice-Chancellor, Dr. Raymond Priestley, spoke of the future of the universities. "University education properly directed could be a mighty means towards the salvation of mankind. University education as it is to-day must accept its share of responsibility for our present plight." The most urgent need of the University of Birmingham is funds to effect the transfer of the Faculties of Arts, Law and Education, the University Library and central administrative offices, from the city to Edgbaston. Then three more hostels are required for the men and one for the women, and a headquarters for the extra-mural department which deals with adult education. This much is necessary to accommodate post-war students, a large proportion of whom will be men and women who have been taught, in the school of war, to know what they want and to see that they get it. The University should be ready to help in training the experts and the teachers of the devastated lands. The Council has already promised to take without fee a number of Chinese students.

Dr. Priestley spoke of some innovations which have been made. When the University decided to make physical training compulsory for all first-year students, it was intended to appoint a whole-time University medical officer whose business was to be the routine examination of all men students (most of the women were already examined on entry) and to keep a constant watch on the physical education programme. The demand of the Services for medical men, however, made it impossible to carry out the plan as originally intended; but the post has been filled on a temporary basis by the appointment of a member of the clinical staff (Dr. G. A. Auden). Another innovation was the establishment by the Faculty of Arts of special courses in modern studies, in view of the reorganizations which are bound to follow the end of hostilities. These courses deal with modern history, geography and modern political theory, and require the study of a foreign language. They are combined with a 'conference' consisting of lectures on present-day world-affairs, followed by short discussions. In the Department of Zoology, Prof. Lancelot Hogben has organized a course of lectures on social biology (open to all the University), which is intended to give some knowledge of the biology of man, of nutritional, housing, and sanitary standards, vital statistics, human heredity and educability, and of the biology of useful and destructive animals and plants. The course has been well attended.

Discoveries at Velikie Bolgary

THE site of Bolgary on the Volga just below the confluence with the Kama has been known since the eighteenth century. It is interesting as the most northerly outpost of Islam. It is marked by ruins of mosques, baths and other public buildings characteristic of a Moslem town, and on its site have been found tiles, fragments of fresco, mirrors and coins. The inhabitants were Turks of a sort; another branch of them settled in the Balkans and founded the Bulgar State. On the Volga the Chuvash are their descendants. Their State is mentioned by all the Musulman geographers. After some prosperity lasting from the tenth to the thirteenth century, it was destroyed by the Mongols, but the city lingered on for another century. Its place has been taken by Kazan. Prof. Alexey Smirnov reports that from 1938 until the outbreak of the war with Germany he has been excavating the site, the White and Black Halls (baths), a minaret, mausolea, a large paved square and remains of wooden houses and grain pits. The baths show the traditional perfection of the eastern bath. The finds are being carefully preserved for the Autonomous Tartar Republic.

Portuguese Anthropological Studies

PROF. A. A. MENDES CORRÊA has published, from the Institute of Anthropology of the Faculty of Sciences of the University of Oporto, under the title "Da Raça el do Esperito", a volume of essays on various anthropological subjects ranging from crime from an anthropological point of view to the Japanese in Brazil; from a study of the Portuguese people to race and moral values. Prof. Mendes Corrêa is well known as an anthropologist and many of his ideas will be found interesting. It is perhaps a pity that he has chosen to write in a language which cannot be said to be universally known. The same author recently read a paper before the sixteenth congress of the Spanish Association for the Advancement of Science, which was held at Zaragoza in 1940. His subject was "Perspectivas duma anthropologia citológica". Once again, however, the language difficulty supervenes. This could perhaps have been overcome by the addition of short summaries in French or English.

Coloured Arc in the Sky

MISS F. E. PENROSE states that on February 8, between 4 and 4.15 p.m. B.S.T., she saw from the East Cliff, Bournemouth, "a portion of a 'bow' resembling a rainbow almost overhead. About a fifth of the arc—the southern portion only—could be seen against a blue sky mottled with white cloud. Had the arc been complete, it would have formed a ring very slightly south of the zenith. It was not raining at the time".

There can be little doubt that this was the rather rare 'arc of contact' to the halo of 46°, described by Dr. F. J. W. Whipple in the "Dictionary of Applied Physics", vol. 3, p. 532, for although no such halo is mentioned, the halo, if visible at all, is apt to be faint, and the coloured arc at its best is a magnificent display of the colours of the spectrum. The Bournemouth description is in general agreement with a similar appearance seen near Stroud (Glos.) in the early afternoon of January 26, except that near Stroud both the 22° and 46° haloes were present, together with part of the mock sun ring and two mock suns, while the arc seemed to the present writer to be centred on the zenith. A similar coloured arc was seen in Wiltshire on January 21. This arc is apt to be too high in the sky to attract notice in normal times, and may seem to be getting more common merely because so many people now systematically examine all parts of the sky that an appearance of this kind can scarcely be overlooked.

Eradication of Wild Onion

WILD onion is a troublesome weed on heavy land in many English counties as well as in vast areas of the United States and Central Europe. It poses a serious problem to the farmer as it has the property of tainting milk and wheat, and once established is extremely difficult to eradicate from either pasture or arable land. Hitherto only partial success has attended measures for its control, but Mr. J. R. Tinney of Saffron Walden has worked out a specific scheme of crop rotation by means of which he has successfully rid his own land of the pest. Details of the method are given in *Agriculture*, **49**, 155 (1943). The essential features of the scheme are: (1) a succession of spring-sown crops for six years, the first of which should be potatoes or roots, there being two cleaning crops during the first three years, and (2) the omission of autumn sown crops or bare fallow. The time of ploughing is specifically stated, and this must be rigidly adhered to in order to give the plants a check when most vulnerable. Drainage is also important. Seven rules of procedure are given with the reasons why they should be followed, and provided the farmer has sufficient perseverance to carry out the instructions, there seems every hope that his efforts will be attended with permanent success.

History of the Tomato

A SHORT paper on "The Evolution of the Cultivated Tomato" by Dr. L. C. Luckwill (*J. Roy. Hort. Soc.*, **68**, Pt. 1; January 1943) shows that only one of the six species of the genus Lycopersicum is cultivated, though several wild kinds have supplied parentage for improvement by hybridization. Most primitive forms belong to the sub-species *Galeni* of *Lycopersicum esculentum*, and a good deal of improvement by selection was probably done by the natives of South America. The plant was first cultivated in Europe on the coastal plains of Spain and Portugal about 1535 A.D., spreading via Italy and Holland to Great Britain. This early cultivation yielded irregular, fasciated fruits, which were the typical produce until more than three centuries later. The change to a regular fruit is thought to have arisen as the result of a reverse mutation from the recessive to the dominant condition. Suggested lines for future improvement are the attainment of hybrid vigour (heterosis) by the crossing of well-chosen parents.

Co-operation in Research

RESEARCH workers will be interested in the way in which the method of co-operation in scientific investigation has been developed at the Franklin Institute (Reports of the Biochemical Research Foundation of the Franklin Institute, 6, 1940–41). The department has heretofore been the unit for achieving co-operation, and in an endeavour to attain closer correlation, the rigid division into departments has been eliminated. Under the new scheme, a round-table conference takes the place in part of the former

department heads. Each member of this conference represents the group engaged in one particular phase of research, so that in this way a fan-like arrangement results in which all radii converge upon a focal point, the director. This enables the individual investigator to exercise his initiative and ability while at the same time the director is closely connected with each worker and each investigation. One example, with far-reaching therapeutic possibilities, that of the discovery of a substance from soil bacilli which inhibited the encapsulation of Friedländer's bacterium and at the same time was highly bactericidal for Gram-positive micro-organisms, is given to illustrate the value of co-operation in research. This substance, discovered by a microbiologist, was at first obtained in crude form; it was passed to the bacteriologists and cytologists to determine its qualities and powers, to the microchemists for analysis, identification and determination of probable composition, to the organic chemists for fractionation, to the spectroscopists for characterization, to the cytologists for toxicity, to the microscopists for record of crystalline struction, to the physical chemists for determination of its constants and further study of its structure, and to the surgeons for study of its external effects on badly infected wounds. The Foundation moved, in December 1940, from Philadelphia to new laboratories at Newark, Delaware, which contain wings to house such physical aids to research as a cyclotron. These laboratories were planned from the point of view of co-operation and co-ordination of research workers of various phases of chemistry, physics, enzymology, biology, cytology and medicine, so that a united effort may be made along one front for the advancement of science and the benefit of mankind.

Electricity Supply Tariffs

C. T. MELLING, in a paper on "General Factors Affecting the Unification of Electricity Supply Tariffs" read on February 4 before the Institution of Electrical Engineers in London, discusses the general requirements of tariffs, and the fundamental aspects of the demand for electricity. The charge for electricity should be based on service value more than on the cost of supply, but there should be suitable controls to safeguard the individual consumer. The limitations of cost analysis in tariff-building are discussed, and it is pointed out that the need for more information on marginal costs demands more intensive research. The difference in the cost of supply in various undertakings, due to differences in bulk-supply charges and in types of area and load, has an important bearing on tariff unification, and a close examination of the economic and social implications of uniformity of charges throughout Great Britain is desirable before a definite decision is made on this matter. Small supplies to domestic and business premises are discussed in relation to the influence of non-monetary factors, as is also the space-heating load and the need for improvement in the bases of the fixed charges in two-part tariffs. Suggestions are outlined for a uniform system of tariffs, and an appendix to the paper contains an analysis showing the difference in cost of supply between urban and rural areas.

Electrical Aspects of Ferro-Alloy Manufacture

H. A. SIEVEKING (*J. Inst. Elec. Eng.*, **90**, Pt. 2 No. 13; February 1943) has discussed the use of, and the power supply to, the submerged-arc electric furnace in connexion with ferro-alloy manufacture. The principal ferro-alloys, the method of grading and their uses are first summarized, and representative electricity consumptions per ton of finished alloy are given. In order to indicate the magnitude of the load, statistical information regarding the quantity of electrically manufactured ferro-alloys is next given over a period of years. This is followed by a description of the type of furnace used, together with brief notes on the electrical equipment and details of the electrodes. In order to indicate the importance of electricity costs, the selling price of typical ferro-alloys is given and, for comparison, the proportion of the selling price represented by each tenth of a penny per kWh. It is also pointed out that supplies of raw material are as easily available in Great Britain as they are in the major ferro-alloy producing countries, namely, Norway, Sweden, and the United States.

In order to establish the price at which electricity can be made available, typical costs of production for a 50,000 kW. steam station are given and, on 1939 costs, a price of ¼*d.* per unit is arrived at. A comparison is also drawn with hydro-electric power and it is shown that, for equality of production costs, all other things being equal, the capital expenditure in a hydro-electric station could be as high as £72 per kW. installed. The disadvantages of a number of private generating stations are obvious, and it is shown that an electricity supply obtained from the Grid is more advantageous. Finally, some typical costs of production for ferro-alloys are given. It is contended that the introduction of a full ferro-alloy industry into Great Britain would offer to the electrical industry a load of some 500 million kWh. per annum, which would require a maximum demand of 75,000 kW. These electricity requirements would have to be made available at a very low price in order that the selling price of the imported alloy should not be exceeded. Employment would not be large as a result of this industry, but the protection which the steel industry would have through the vital ferro-alloys being readily available at all times would appear to be sufficient justification for giving careful consideration to the possibility of establishing ferro-alloy factories in Great Britain, more particularly when it is borne in mind that the furnace used can be adapted readily at any time to the manufacture of calcium carbide, an equally important raw material which in pre-war days was largely imported.

New Reference Frequency Equipment

ACCORDING to V. J. Weber (*Bell Lab. Rec.*, **21**, No. 3; November 1942) frequencies in radio and carrier telephone are now held constant to a very high degree of precision, and for the manufacture of radio and telephone apparatus it has been necessary to develop frequency standards of even greater precision. For the Hawthorne plant of the Western Electric Co., the Bell Laboratories have recently developed new reference frequency equipment which is interesting as an embodiment of the most modern technique. This equipment provides frequencies, accurate to two parts in ten million, of 100, 10, 1·0 and 0·1 kc., which may be distributed as desired about the Hawthorne plant. It also includes apparatus to detect any errors in these frequencies, and in such cases to give an alarm if the error exceeds a certain very low value. Two independent reference frequency supplies are provided, which is advan-

tageous in making equipment available should trouble develop in one source. It also enables a continuous check to be maintained of the difference between the frequency of the two sources, and thus gives prompt indication of any incipient trouble.

A basic frequency of 100 kc. is generated by an oscillator circuit in an upper panel, and immediately below this is a 100 kc. amplifier. Below this again are three panels, producing submultiple frequencies of 10 kc., of 1 kc. and of 100 cycles. Another bay is provided for frequency checking which, besides providing for comparing the two frequencies with each other, also permits either to be checked against a standard 5 mc. frequency sent out over Station *WWV* by the National Bureau of Standards in Washington. A further bay provides independent power supplies for each of the three units. Power is taken at 117 volts and 60 cycles from the commercial supply, and from it four units produce regulated D.C. for plate supply, while a fifth unit supplies regulated A.C. heater voltage. There is one D.C. power supply for each of three bays, while a fourth serves as a spare, and may be connected in place of any of the other three by running cords between them.

Preservative for Telephone Poles

To be effective in prolonging the life of wood in contact with the ground, water-soluble materials must undergo a change after injection which will render them insoluble while retaining their preservative value. An article by C. M. Hill (*Bell Lab. Rec.*, 21, No. 3; November 1942) discusses a new preservative, now known as 'greensalt'. The composition mostly used contains potassium dichromate, copper sulphate and arsenic acid in solution. Variants include sodium dichromate as a substitute for the potassium salt, and also mixtures of chromic acid, copper carbonate and arsenic acid. These preservatives, particularly the first one, have been given extensive laboratory tests to determine their preservative value in wood and their permanence.

Small blocks of southern pine sapwood were impregnated with solutions of graded concentration and afterwards subjected to the attack of wood-destroying fungi under controlled laboratory conditions. Blocks similarly impregnated were subjected to exhaustive leaching, and the leach waters were analysed for copper, chromium and arsenic; the leached blocks were then exposed to fungus attack. The tests showed that greensalt became almost completely insoluble within a short time after injection, and both leached and unleached blocks satisfactorily withstood fungus attacks. Outdoor exposure tests on southern pine saplings 1 in. in diameter and posts 4–5 in. in diameter treated with greensalt were begun in 1934 under conditions very favourable to rapid destruction of wood in contact with the ground. The seven-year record of exposed specimens treated with $\frac{1}{2}$ lb. and 1 lb. of greensalt preservative per cu. ft. of wood is excellent in comparison with simultaneous similar tests of preservatives of established standing, including creosote.

Wood Pigeon Investigation

THE report of the Edward Grey Institute's wood pigeon investigation in 1942, recently issued in the Wood Pigeon Bulletin No. 4, makes interesting reading in view of the concern over this bird's damage to war-time crops, for 1,734 nests were recorded on habitat cards and 32,276 birds recorded in field counts in the first six months of the year. Comparison is made between 458 nests recorded from northern England and 1,084 from the south, and the seasonal distribution of the percentage of nests respectively was, after May 31, 91 and 86; after June 30, 67 and 68; after July 31, 37 and 45; after August 31, 14 and 19. Two thirds of the nests were found after June 30, confirming earlier indications of the species' late breeding habits. Of the field counts, only a quarter were on clover and just over a quarter on corn, and over the whole country, on the average, the greatest number of wood pigeons was seen in January and February, after which there was a steady decline, the June figures being only one fifth of the February peak. More birds were recorded per observer in the south than in the north, but the maximum was in the Midlands. Regarding the wild food of these birds, phenologists of the Royal Meteorological Society record that, partly owing to the absence of late frosts in 1942, both oaks and beeches fruited more plentifully than in 1941; oaks fruited best in the north and west, and beech fared worst in the south. A plague of caterpillars in May, it is noted, may cause wood pigeons some six months later to turn their attention to cultivated crops.

Staffordshire Ecology

THE 1942 report issued by the East Staffordshire Branch of the British Empire Naturalists' Association contains recorders' reports on the faunal and floral survey conducted during the year at four selected localities—Sutton Park, Hopwas Woods (Tamworth), Randan Woods, and Minworth Sewage Works. In the Randan Woods lists, F. Fincher includes the badger, winter siskins, the nightingale and nuthatch, a male golden oriole on May 26, but the nightjar has disappeared as a nesting species. Butterflies are increasing, notably wall brown, comma, the pearl-bordered fritillaries, speckled wood, large skipper, while rare records in 1942 included the wood white and white-letter hairstreak. Seven species of Bombus (Hymenoptera), four of Vespa and three of ants were noted. Of the flora, adder's tongue fern and twayblade have increased. N. Grove and M. H. Asterley record as visitors at Minworth Sewage Works many duck and waders, the reed warbler nesting, 119 house-martin nests under the eaves of a power house the roof of which was burnt out during the previous winter. Major A. de Hamel's lists for Tamworth note an increase of jackdaws, jays, spotted flycatchers and swifts, and a decrease of swallows, house martins, and wood pigeons. The willow tit is included. Grasshoppers, dragonflies, beetles and fungi are also listed in the reports of the recorders, and there are notes from some other localities, including white helleborine at King's Norton.

Mythology of Cancer Research

UNDER this heading, the *Lancet* of December 26 has an article by Prof. E. L. Kennaway, who states that the literature of cancer research contains frequent references to an alleged piece of evidence for the carcinogenic action of arsenic recorded by Dr. J. A. Paris, F.R.S., senior physician to West-

minster Hospital, in a book entitled "Pharmacologia", which reached its third edition in 1820 and its fifth in 1822. According to Paris, the poisonous effects of arsenic were seen in horses and cows, which lose their hoofs, while the latter suffer from a cancerous affection in their rumps. Seventy years after the appearance of the fifth edition of Paris's book, Mr. Henry Butlin, surgeon to St. Bartholomew's Hospital, made elaborate investigations into the truth of Paris's statements about the carcinogenic action of arsenic on animals but without finding the smallest evidence of their truth. Later writers, such as Hueper, Nieberle, Prehl and Hofmann, refer to Paris's statements but without bringing any evidence as to the occurrence of cancer in animals being due to arsenic. Prof. Kennaway comes to the conclusion that statements such as those of Paris should be fully investigated before they become incorporated in text-books.

Panamerican Sanitary Congress

AN article in the November issue of the *Boletín de la Oficina Sanitaria Panamericana* states that a very high place must be given to the Panamerican Sanitary Congress, which was held in Rio de Janeiro during September 7–18, 1942. Every Republic of South America was represented, and all, with one exception, by specialists including directors and professors of hygiene and authorities on tropical medicine, venereal disease, malaria, tuberculosis, bacteriology, radiology, forensic medicine, dietetics, aerial quarantine, dermatology and public health administration in general. The United States delegation consisted of six members, that of Paraguay eight and that of Chile ten, while that of Brazil was naturally larger. The Dominion of Canada was represented for the first time. The problems discussed consisted of the role of public health in the defence of the hemispheres, followed by more or less closely connected subjects such as malaria, typhus, nutrition, plague, influenza, tuberculosis, quarantine, yellow fever, trypanosomiasis, dysentery, cancer, heart disease and sanitary engineering. Caracas, Venezuela, was selected as the site for the next Congress, which is to be held in 1946.

Hospital Admissions in U.S. Rural and Urban Areas

THE issue of *Public Health Reports* of October 30 contains an interesting survey by Selwyn D. Collins, principal statistician, United States Public Health Service, of variation in hospital admissions with the size of city, family income and other environmental factors. The survey is based on records for 8,758 families in 130 localities in eighteen States. Hospital rates were lower for rural than for urban areas, and were lower for small towns than for large cities. In cities the highest rates for admissions and days of hospital treatment occurred in the highest and lowest income groups, while in rural areas the lowest income group had the lowest hospital rates. The lowest income group in both urban and rural areas had the lowest average days per hospital case. Four important diseases were responsible for about half of all the admissions to hospital, namely, tonsillectomy, deliveries, appendicitis and accidents. The first three diseases tended towards higher percentages of cases admitted to hospital in the higher income-level. In the percentage of cases admitted to hospitals, deliveries showed the largest and most regular increases with income.

Mycological Nomenclature

CHANGES in the naming of a species following increased knowledge can be very confusing, but teachers and students who require a clear statement of the rules of nomenclature as they affect mycology will find it in a series of four short papers by Miss E. M. Wakefield, E. W. Mason, G. R. Bisby and J. Ramsbottom (*Trans. Brit. Mycol. Soc.*, **25**, Pt. 4, pp. 428–439; December 1942).

Announcements

OWING to the generosity of the Rockefeller Foundation which has for a third year in succession provided a grant for the purpose, the Royal Society is in a position to give some assistance to scientific societies and associations which, as a result of war conditions, are experiencing financial difficulties in the publication of scientific journals.

THE University of Leeds has accepted a gift of £50,000 from Mr. Henry Ellison, to create an endowment fund for the provision of post-graduate fellowships for research in pure and applied chemistry and in physics.

AT the annual general meeting of the Society of Public Analysts and Other Analytical Chemists held on March 3, the following were elected officers and council for the coming year: *President:* S. Ernest Melling; *Past Presidents serving on the Council:* F. W. F. Arnaud, Bernard Dyer, John Evans, Edward Hinks, E. B. Hughes, G. Roche Lynch, W. H. Roberts and G. Rudd Thompson; *Vice-Presidents:* H. E. Cox, G. Hogan, T. Rendle, W. Gordon Carey (chairman, North of England Section) and A. R. Jamieson (chairman, Scottish Section); *Hon. Treasurer:* George Taylor; *Hon. Secretary:* Lewis Eynon; *Other Members of Council:* J. W. Corran, R. H. Ellis, J. G. A. Griffiths, D. W. Kent-Jones, R. Lessing, H. M. Mason, B. G. McLellan, M. Pearson, W. H. Simmons, R. W. Sutton, E. Voelcker, K. A. Williams, Arnold Lees (hon. secretary, North of England Section) and R. S. Watson (hon. secretary, Scottish Section).

A NEW editorial board of *Endocrinology* has been appointed as follows: J. S. L. Browne, Department of Medicine, McGill University; E. T. Engle, Department of Anatomy, College of Physicians and Surgeons, New York; Carl G. Hartman, Department of Zoology, University of Illinois; E. C. Kendall, Division of Biochemistry, Mayo Clinic; F. C. Koch, Department of Biochemistry, University of Chicago; C. N. H. Long, Department of Physical Chemistry, Yale University School of Medicine; and H. B. van Dyke, Squibb Institute for Medical Research. The managing editor is E. B. Astwood, of the Departments of Medicine and Pharmacology, Harvard Medical School; the associate managing editor is E. W. Dempsey, of the Department of Anatomy, also of Harvard Medical School.

A RESEARCH scholarship of the value of £400 per annum and tenable for two years has been offered by the Wrought Light Alloys Development Association to encourage and facilitate research in the application of light alloys to ship construction. The scholarship will be administered by a Committee of the Institution of Naval Architects and it is hoped to make the award in September next. Full particulars of entry, which closes on July 31, can be obtained from the Secretary, Institution of Naval Architects, 10 Upper Belgrave Street, London, S.W.1.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Physiological Action of Acetic Acid in Living Tissues

STARTING from the general thesis that volatile acids are produced in large quantity in the rumen of the sheep, McAnally and Phillipson[1] showed that some at all events of these acids are absorbed from the rumen and are found in considerably greater quantities in the blood coming from that organ and from the large intestine than in the blood coming from other parts of the alimentary canal.

They showed further that of the acids so absorbed acetic appears to be the preponderant one.

The fate of acetic acid then demands consideration. Among other possibilities is that of its being destroyed in the tissues. To test this the mammalian (rabbit's) heart was perfused with Locke's solution in which, for the glucose, sodium acetate was substituted.

As the accompanying table shows, the sodium acetate disappeared on the same sort of scale as Locke and Rosenheim[2] found glucose to be consumed.

Serial number	Weight of heart (gm.)	2-hour period	Acetate introduced at the commencement of each 2-hour period (mgm.)	Acetate disappearing in 2-hour period (mgm.)	Remarks
1	2·8	1st period	134	56	
		2nd "	"	52	
		3rd "	"	28	
2	5·35	1st "	"	28	Heart not beating
3	4·60	1st "	"	66	
		2nd "	"	54	
4	5·2	1st "	"	36	1·7 mgm. acetate recovered from heart at end of exp.
		2nd "	"	34	
5	4·6	1st "	141	54	0·8 " "
Controls in which the heart was replaced by a piece of rubber tubing.					
1	—	—	134	5	
2	—	—	134	4	

That acetate has some merit, however, under the conditions of our experiments, is shown by the fact that, whereas we have maintained the hearts beating up to 4–6 hours on solution containing acetate, on the same solutions, free of acetate, they have not beat for more than two hours.

Whether or no the acetic acid is oxidized is under investigation, but whatever its fate may be, the fact that it does disappear opens wide fields for speculation.

JOSEPH BARCROFT.
RACHEL MCANALLY.
ANDREW PHILLIPSON.

Unit of Animal Physiology,
at Department of Physiology,
University,
Cambridge.
Feb. 24.

[1] McAnally, R., and Phillipson, H. T., *Proc. Physiol. Soc.*; *J. Physiol.* (in the press).
[2] Locke, F. S., and Rosenheim, O., *J. Physiol.*, **36**, 205 (1907).

Structure of Keratin Fibres

THE chief studies of keratin fibres have been carried out on wool and human hair. In these cases cortical cells constitute the bulk of the fibre substance, and readily lend themselves to physico-chemical examination[1]. The majority of mammalian fibres, however, are heavily medullated and possess a cuticular layer which may vary in thickness from 3 μ to 10 μ. A study of different types of animal fibres has shown that this histological differentiation is paralleled by chemical reactivity. The following results, obtained on treating transverse sections[2] of Kolinsky (*Mustela Siberica*) guard-hairs with various reagents, are representative of the chemical characteristics of cuticle, cortex and medulla.

Reagent	Result
5% NaOH. 2 hr. 22·2° C.	Cuticle partially attacked, complete solution of cortex, medulla undamaged.
5% $Na_2S.9H_2O$. 18 hr. 22·2° C.	Cuticle swollen and showing platelet structure, almost complete solution of cortex, medulla intact.
Chlorine water. 15 min. 22·2° C.	Cuticle very swollen and separating into platelets, cortex and medulla intact.
4*N*.HCl. 10 min. boil → 5% aq. Sod. Naphthaquinone-4-sulphonate. 18 hr. 22·2° C.	Faint colour in cuticle, very intense coloration in cortex, medulla colourless.
Millon's Mercury Reagent. 18 hr. 22·2° C.	Faint colour in cuticle and cortex, intense colour in medulla.
Van den Bergh's Diazo-Reagent. 18 hr. 22·2° C.	Faint yellow colour in cuticle and cortex, more intense colour in medulla. Colour apparently unchanged by Totani histidine test.
0·25% Trypsin. pH 8·5. 35° C.	Complete solution of medulla after 15 min., cuticle and cortex intact after 3 weeks' treatment.

It will be noticed that sodium hydroxide and sodium sulphide, reagents which cause fission of the disulphide bond[1], are most reactive with those parts of the fibre which the Sullivan test shows contain the greater proportion of cystine. The major portion of reactive tyrosine is located in the medulla region.

a *b*

(×560)

Fig. 1.

When transverse sections of guard-hairs from the Russian hare (*Lepus variabilis*) are dyed in neutral or acid solutions of basic dyes, the dye is absorbed preferentially by the medulla. Uniform dyeing results from an alkaline bath. Acid dyes in neutral solution dye only the cortex, but in acid solution dye both cortex and medulla. Fig. 1 shows the

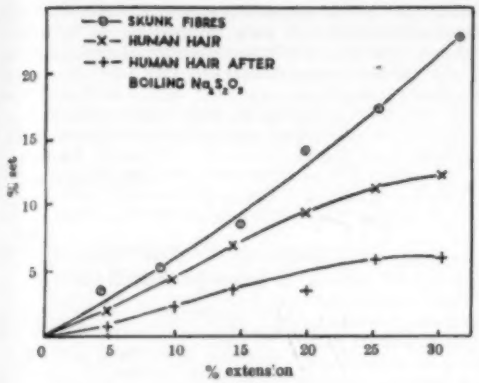


Fig. 2.

results obtained after (*a*) 1 hr. in boiling 0·1 per cent Safranine *B*, (*b*) 1 hr. in boiling 0·1 per cent Kiton Red G. Ermine (*Mustela erminæ*) fibres behave in a similar fashion.

The physico-chemical properties of mammalian guard-hairs also are different from those of human hair and Cotswold wool. White fibres from the skunk (Mephitis), degreased and boiled under tension in 2 per cent borax for 30 min., attain a greater permanent set than do human hair fibres, and in the former case the set is stable to boiling 5 per cent sodium metabisulphite solution (Fig. 2). Untreated skunk fibres also show much smaller supercontraction than is observed with wool or human hair. X-ray diffraction patterns, kindly photographed by Dr. K. M. Rudall, suggest that this difference in setting properties of skunk fibres and human hair is not due to the presence of different amounts of crystalline keratin. The orientation of polypeptide chains in the cuticle, together with the value of the cuticle/cortex ratio, are probably the factors governing setting and supercontraction in mammalian guard-hairs.

A more detailed account of these experiments will appear elsewhere.

J. L. STOVES.

University,
Leeds. Feb. 12.

[1] Stoves, J. L., *Trans. Farad. Soc.*, **38**, 254, 261, 501 (1942).
[2] Stoves, J. L., *Analyst*, **67**, 385 (1942).

Isomers of Stilbœstrol and its Esters

IN the course of experiments on the synthetic œstrogens, it became evident that the substance, m.p. 140–142°, obtained by Dodds, Golberg, Lawson and Robinson[1] from the liquid modification of 4 : 4′-dimethoxy - α : β-diethylstilbene, and hitherto considered to be an isomer of stilbœstrol (4 : 4′-dihydroxy - α : β-diethylstilbene)[1,2], was probably a mixture.

Similar material, m.p. 140–144°, which analysed as for stilbœstrol, on extended fractionation from benzene, has now yielded two substances: (1) stilbœstrol crystallizing from benzene in long needles, which break down on drying to an amorphous white powder, m.p. 171°, and (2) hexagonal tablets of apparently pure ψ-stilbœstrol, stable on drying and melting at 151° (I). The accompanying m.p. diagram leaves little doubt as to the purity of the latter compound, whereas the material, m.p. 140–142°, is seen to be approximately a eutectic mixture, containing 60 per cent ψ-stilbœstrol and 40 per cent stilbœstrol. Pure ψ-stilbœstrol can be converted into stilbœstrol in 80 per cent yield by heating with alcoholic hydrochloric acid.

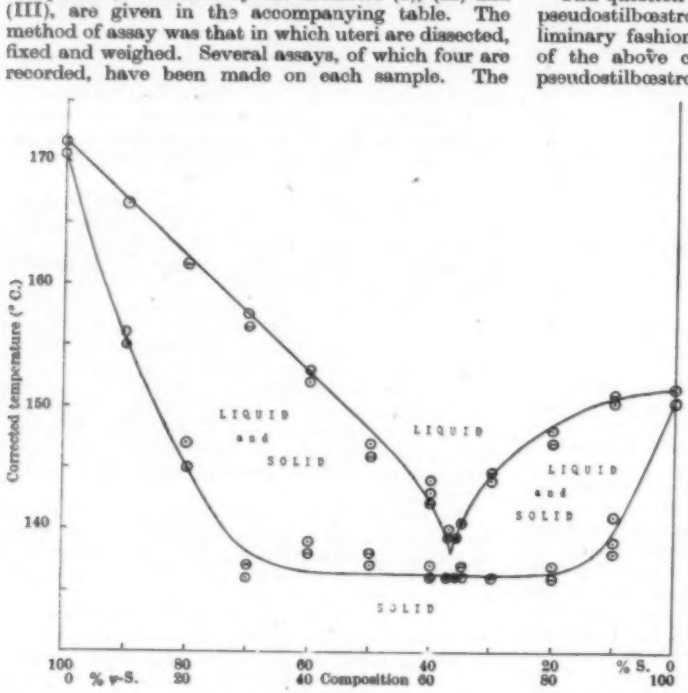
The esterification of stilbœstrol and ψ-stilbœstrol has also given some interesting results. Stilbœstrol, on treatment with propionic anhydride, yielded, in addition to the known dipropionate (hexagonal prisms, m.p. 107–108°), a second dipropionate (III) (long needles, m.p. 78–79°) by extended fractionation of the second crops from alcohol. The ester, m.p. 78–79°, on boiling (390°) for ½ minute at normal pressure, was partly converted into the dipropionate, m.p. 107–108°. On reduction, it gave a theoretical yield of hexœstrol dipropionate, m.p. 126–128°, whereas the ester, m.p. 107–108°, on similar treatment, gave only an oil from which hexœstrol dipropionate was isolated in small yield. On the other hand, both dipropionates from stilbœstrol gave theoretical yields of the latter on alkaline hydrolysis.

ψ-Stilbœstrol, m.p. 151°, on similar esterification, yielded an oily dipropionate (II), b.p. 255–256°/10 mm., from which a theoretical yield of ψ-stilbœstrol was recovered on alkaline hydrolysis. This oil may prove to be a mixture analogous to that obtained from stilbœstrol.

The comparative biological activities of the three

	Standard			Test	Ratio of Activity to Standard
	Stilbœstrol, m.p. 171°			(I) ψ-Stilbœstrol, m.p. 151°	
Total dose injected	0·8 μ gm.	1·6 μ gm.	3·2 μ gm.	40 μ gm.	
Response of uteri in mgm. ± S.D.	98·0 ± 15	108 ± 14	120 ± 29	118 ± 21	1/14
	Stilbœstrol Dipropionate, m.p. 107–108°			(II) ψ-Stilbœstrol Dipropionate oily	
Total dose injected	0·2 μ gm.	0·4 μ gm.	0·8 μ gm.	10 μ gm.	
Response of uteri in mgm. ± S.D.	39 ± 8	51 ± 3	68 ± 16	63 ± 13	1/16
	Stilbœstrol Dipropionate m.p. 107–108°			(III) Stilbœstrol Dipropionate long needles, m.p. 78–79°	
Total dose injected	0·8 μ gm.	3·2 μ gm.		500 μ gm.	
Response of uteri in mgm. ± S.D.	109 ± 19	129 ± 8		99 ± 11	1/600
Total dose injected	0·4 μ gm.	1·6 μ gm.		250 μ gm.	
Response of uteri in mgm. ± S.D.	83 ± 12	109 ± 8		84 ± 13	1/625

compounds, identified by the numbers (I), (II) and (III), are given in the accompanying table. The method of assay was that in which uteri are dissected, fixed and weighed. Several assays, of which four are recorded, have been made on each sample. The



○, 1 observation; ●, 2 identical observations; ⊕, 3 identical observations.

Corrected Melting Points
Stilbœstrol-ψ-Stilbœstrol Mixtures.

% S	% ψ-S	1	2	3
100	0	170·5–171·5°	—	—
90	10	155–166·5°	156–166·5°	—
80	20	147–161·5°	145–161·5°	–161·5°
70	30	136–156·5°	137–157·5°	137–156·5°
60	40	139–153°	138–152°	138–153°
50	50	137–146°	138–146°	138–147°
40	60	136–144°	136–142° (2)	137–143°
37	63	136–140°	136–139·5°	136–139·5°
36	64	136–139·5	136–139·5°	136–139·5°
35	65	137–140·5°	137–140·5°	136–140·5°
30	70	136–144°	136–144·5°	–144·5°
20	80	137–147°	136–148°	136–147°
10	90	141–151°	138–150·5°	139–151°
0	100	150·5–151·5°		

figure previously reported by Dodds *et al.* for ψ-stilbœstrol corresponded to approximately one third the activity of stilbœstrol; our figure of one fourteenth is in accord with the findings reported here. The biological inactivity of compound III, stilbœstrol dipropionate, m.p. 78–79°, arouses speculation as to its possible structure.

Further work is in progress on the configuration and activity of these and similar compounds, especially in the light of the results of Wessely *et al.*[2,3], and it is hoped to publish a more detailed account later.

E. WALTON.
Wellcome Chemical Works,
Dartford.

G. BROWNLEE.
Wellcome Physiological Research Laboratories,
Beckenham.

[1] Dodds, Golberg, Lawson and Robinson, *Proc. Roy. Soc.*, **127**, 140 (1939).
[2] Wessely and Kleedorfer, *Naturwiss.*, **27**, 567–568 (1939).
[3] Wessely and Welleba, *Berichte*, **74**, B, 777 (1941).

THE question of the homogeneity of stilbœstrol and pseudostilbœstrol has been studied by us in a preliminary fashion, and we concur in the conclusions of the above communication. So far our purest pseudostilbœstrol has mp. 148°, and is evidently still not quite pure. Its biological activity has not yet been assayed.

E. C. DODDS.
R. ROBINSON.

Loss of Phosphorus during Sewage Purification

THE importance of conserving the world's resources of phosphorus has recently been under discussion. The two main causes of depletion are the loss of phosphates from soil by leaching, and the loss of phosphorus compounds contained in sewage. We have completed a preliminary examination of the removal of phosphorus from sewage during purification and obtained results which may be of general interest.

Sewage and garbage are usually disposed of by different methods and at different sites; and since the quantity of phosphorus retained by the human organism is extremely small as compared with that contained in the diet, the phosphorus in sewage, particularly that contained in the sewage which is derived from a residential area, represents closely the amount of the element actually consumed. Some of the results we have obtained might therefore be of special interest to dietitians.

At the Coleshill sewage works of the Birmingham Drainage Board, which purifies the sewage from about 110,000 inhabitants of a residential district, the total phosphorus in the sewage before purification was equivalent to 1·3 gm. phosphorus per head of population per 24 hours. The purified sewage which passed to the River Tame contained 54 per cent of the phosphorus present in the crude sewage, the remainder being accounted for by the phosphorus retained by the sewage solids recovered as a sludge. These figures must at present be regarded as tentative, since under war-time conditions it is difficult to assess the population with accuracy.

The Middlesex Main Drainage Works at Mogden serves a population of rather more than 1,200,000. The sewage draining to this works contains a proportion of phosphorus compounds from certain industries, but this proportion is very small as compared with that which is domestic in origin; and moreover, this small proportion can be fairly accurately measured. Over a period of one month the total phosphorus in the crude sewage derived from both industrial and domestic sources was equivalent to 1·56 gm. phosphorus per head per 24 hours, of which, it has been estimated, 1·51 gm. represents the amount consumed in the diet. The purified effluent discharged to the

River Thames contained the equivalent of 0·62 gm. phosphorus per head per day. In this case 40 per cent only of the phosphorus present in the crude sewage passes to the river, and 60 per cent is retained in the sludge.

It is interesting to note that the total amount of phosphorus excreted is given by Fowler[1] as 1·48 gm. P per head per day; Mathews[2] gives the phosphorus ingested in the food of an adult as 1·2–2·0 gm. P per day, while Sherman[3] regards 1·5 gm. P per day as the lowest intake compatible with safety for the adult.

Armstrong[4] gave the phosphorus in the sewage from Great Britain as equal to 150,000 tons of rock phosphate a year and stated that most of this reached the sea. On the basis of the figures we have obtained, the amount of phosphorus in sewage from a population of 42 million inhabitants is equivalent to about 116,000 tons of calcium phosphate per annum, and by suitable treatment of the sewage, 46–60 per cent of this could be recovered in a usable form.

We hope to make a more detailed study of this subject when circumstances permit in order to supplement the information we already possess, and to extend our investigations by a study of the losses of phosphorus and nitrogen during sewage purification.

S. H. JENKINS.

Birmingham Tame and Rea District
Drainage Board,
Rookery Park, Erdington,
Birmingham, 24.

W. T. LOCKETT.

Mogden Sewage Purification Works,
Isleworth, West Middlesex.

[1] Fowler, G. J., "An Introduction to the Biochemistry of Nitrogen Conservation" (London, 1934), p. 247.

[2] Mathews, A. P., "Physiological Chemistry" (New York, 1924). 3rd Edit., p. 755.

[3] Quoted by Lester, J. S., "Nutrition and Diet in Health and Disease" (London, 1934), 2nd Edit., p. 121.

[4] Armstrong, E. F., NATURE, 150, 453 (1942).

Breeding of a Cotton Immune from Natural Crossing

BALLS ("The Cotton Plant in Egypt", 1912) made the discovery that in the cotton plant, self pollen was somewhat prepotent over foreign pollen, in interspecific crosses between Egyptian cotton (*Gossypium barbadense* L.) and Upland cotton (*G. hirsutum* L.). Thus if stigmas of *barbadense* were pollinated with a mixture of *barbadense* and *hirsutum* pollen, most of the ovules were fertilized with *barbadense*. The reverse was found with *hirsutum*. The prepotency of self pollen over foreign pollen was rediscovered by Jones some years later in maize, and other plants are now known to follow this rule.

But Balls went further and showed that some F_1 pollen was prepotent over self pollen, though he did not deduce any theoretical consequences from this fact. This observation made me believe that in an interspecific cross there must be segregation for velocity of pollen tube growth conditioned by minor modifiers (now called polygenes by Mather). If there were many minor genes for velocity it should be possible to concentrate them by stringent selection and produce new types in which self pollen grew so rapidly that no foreign pollen would grow fast enough to fertilize.

The plan adopted was as follows, and the experiments lasted from 1929 until 1935, when I left Trinidad for Brazil.

The cross:

Upland: *y*, cream corolla	*barbadense*: *Y*, yellow corolla
p, cream pollen	*P*, yellow pollen
s, spotless corolla X	*Sf*, faint spot
r, green plant body	*R*, red plant body

The F_1 showed dominance of *Y*, *P* and *R*. *Sf* could not be usefully employed because penetrance was too low.

The first backcross of F_1 on to the triple recessive hirsutum Upland.

The female triple recessive was selfed at 8 a.m., much pollen being applied. Afterwards F_1 pollen was applied at intervals of one hour later, two hours later, etc., to eight hours later.

Approximately ten bolls with roughly 210 seeds was the objective from each of the treatments.

The results. As my notes were all lost on leaving Trinidad I can only give very approximately the nature of the results.

It was found that a considerable number of F_1 pollen tubes could beat the self tubes even when the latter had four hours start. A hundred plants were grown from each treatment, making eight hundred plants in all. Approximately eleven plants of composition *R Y P r y p* were secured from the four-, five- and six-hour treatments.

It would have been desirable to have tested each of these plants in a similar series of treatments to those given above, but time and space did not permit of this.

For the second backcross on to *hirsutum* triple recessive a mixture of pollen from all the eleven plants was used.

The second backcross results. The exact numbers are not available, but it may be said that a *much greater number of foreign tubes* were able to fertilize at the four-, five- and six-hour intervals.

The third backcross. The pollen of ten *R Y P r y p* plants was mixed and applied at the same intervals after self-pollination.

The number of plants from foreign pollen was slightly superior to the number in the second backcross, and the whole population was Upland in most of its characteristics.

The self population. All plants resulting from the four-, five- and six-hour treatments, about sixty in number, were self-fertilized, and grown in progeny rows. All triple recessives were self-fertilized, to create a series of lines identical with Upland except for the presence of the rapid pollen tube genes.

Five plants only were available to continue the experiment. Progeny rows of the five were interspersed among a collection of mixed hybrids of *hirsutum*, *barbadense* and *purpurascens* ancestry.

If we had been successful in concentrating some of the rapid pollen tube growth genes, some plants in these five rows would breed true to type *r y p* and vegetative characteristics and could therefore be termed immune to natural crossing.

Unfortunately the experiment was interrupted at this point, and has only recently been resumed. Its practical importance for application to other crops is too obvious to need emphasizing.

S. C. HARLAND.

Institute of Cotton Genetics,
Lima, Peru.
Jan. 19.

An Exceptional Increase of Cosmic Rays?

In a previous communication[1], an account was given of the hourly records of the intensity of cosmic rays which are being obtained by making use of a battery of Geiger counters registering threefold coincidences. No absorbing screens are used.

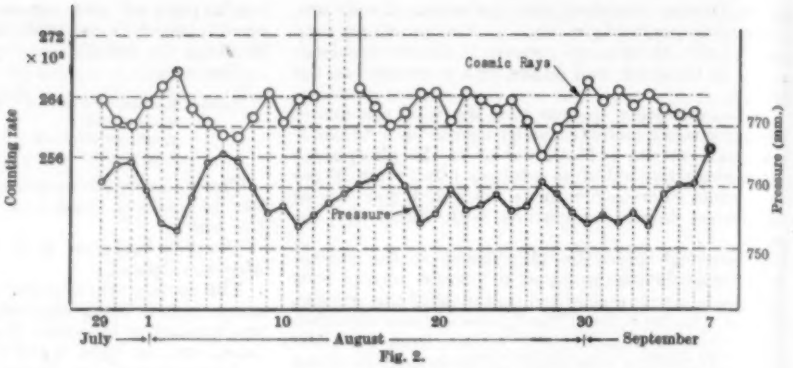


Fig. 2.

The records generally show that the changes in cosmic rays from day to day are more or less what can be expected from well-known geophysical influences. Nevertheless, last August a transient change was recorded which apparently cannot be ascribed to any of these influences. The points on the diagram of Fig. 1 represent the hourly counting rate for the period August 12–15, 1942. The scale is in percentages from the normal value. The rapid and quite unusual increase which began at about 18h. (G.M.T.) August 13 was preceded by fluctuations in the counting rate which are not common in the absence of magnetic activity. When these fluctuations were being observed it was considered advisable, in order to test the apparatus, to substitute a new pair of thyratrons for the first pair in the counting circuit. The point corresponding to 12h. on the diagram had already been observed after putting in the new valves. These were permanently retained, and the other parts of the apparatus had remained untouched.

As the diagram shows, the results of the first few observations made with the new thyratrons and those which follow the great increase are entirely comparable with the results of previous observations. To what extent this is true may be inferred from the diagrams in Fig. 2. The larger circles represent the averages of the hourly counting rate per day, and the smaller circles the corresponding average atmospheric pressures. Furthermore, the old pair of thyratrons was replaced a month later and again the results did not show any marked difference. In any event, it would be difficult to explain how so sudden, great and regular a change of pulse-rate could be the result of changing the valves. Thus everything seems to point to the conclusion that the relation in time between the substitution of valves and the sudden increase in counting rate was accidental. It thus becomes probable that the observed increase of pulse-rate actually represents an increase of cosmic rays.

However, it seems that this phenomenon cannot be explained by any unusual geomagnetic activity. From information kindly given by the Royal Observatory, Greenwich, it appears that the magnetic field remained perfectly calm during the period August 13–14, and that the only disturbances recorded, on August 10, 15–17, and 22–24, were slight, with a range in the horizontal magnetic force H of 110γ, equivalent to about $-0{\cdot}6$ per cent of the H value.

In order, therefore, to account for the great influx of particles, it would probably be necessary to assume that they entered the earth in the form perhaps of a stream superimposed on the ordinary cosmic radiation. With regard to their energy, they should have at least the minimum energy necessary for primary particles to produce any appreciable effect at sea-level. From the results obtained by Bowen, Millikan and Neher[2] at different latitudes in their investigation of the variation of cosmic ray intensity with altitude, and also from Lemaître-Vallarta's calculations[3], this lowest energy can be estimated to be about 5×10^9 eV. This is about the energy necessary for charged particles to reach vertically the magnetic latitude of 44°. Now from information kindly communicated by the Department of Terrestrial Magnetism, Carnegie Institution of Washington, no increase was recorded at Cheltenham, U.S.A. It is necessary, therefore, to assume that the secondaries produced at sea-level

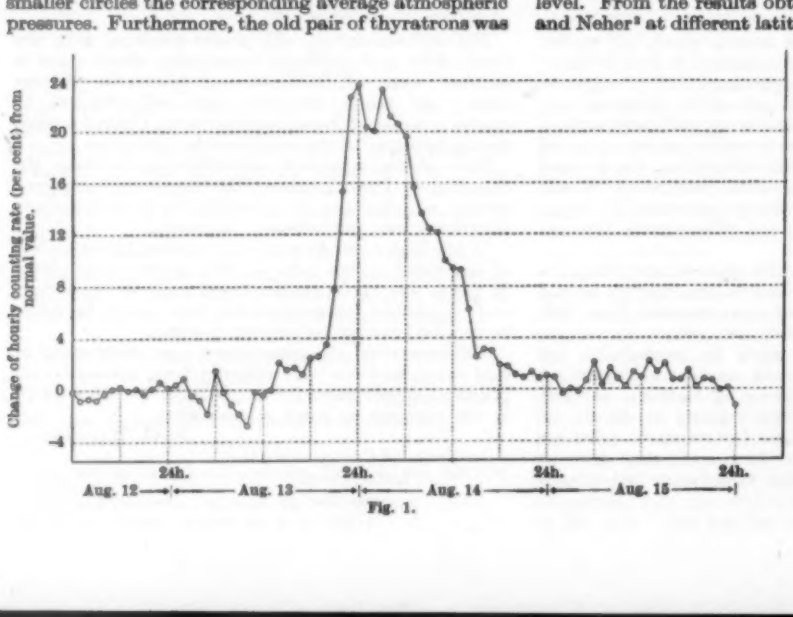


Fig. 1.

were only penetrating enough to pass through the counter set in London ($\lambda = 54°$), and too absorbable to penetrate the 12 cm. of lead shield which protects the ionization chamber in Cheltenham ($\lambda = 51°$). Consequently, it is probable that the energy of the abnormal primary particles did not extend much further than 6×10^9 eV. Owing to the absence of reliable counter measurements at magnetic latitudes higher than 44°, it is difficult to estimate the contribution of primaries of such an energy to the cosmic-ray intensity at sea-level. But it is obvious that the smaller this contribution is, the greater will be the proportion of new particles represented by the peak value of Fig. 1 in relation to the number of particles of the same energy at normal times. If the normal is, say, 1 per cent, then we have been receiving, during some hours of the night of August 13–14, a stream of more than twenty times the normal number of $5–6 \times 10^9$ eV. particles.

Jánossy[4] and later Vallarta[5] have pointed out that the magnetic field of the sun may be responsible for the latitude 'cut-off' effect in the cosmic-ray energy spectrum incident on the earth. If so, one could imagine that on August 13–14 a disturbance of the sun's magnetic field occurred which allowed particles to reach the earth that otherwise would have been stopped. But according to Epstein's[6] calculations, in order to cut off particles of 5×10^9 eV., it would be necessary for the heliomagnetic field to be of a value much greater than 50 gauss, which is the upper limit obtained from spectroscopic measurements. Such a value is very unlikely.

So far as is known to me, there has never before been recorded so great an increase of cosmic rays which has extended for such a length of time. On August 17, 1941, our apparatus registered a quite abrupt increase of more than 30 per cent, which lasted only from 1h. until 3h. Also last March two sudden increases of about 7 per cent were recorded in Cheltenham[7] and London, which lasted not more than four hours each. But these were probably associated with magnetic storms.

A. DUPERIER.

At the Department of Physics,
Imperial College of Science and Technology,
London, S.W.7.

[1] Duperier, NATURE, **149**, 579 (1942).
[2] Bowen, Millikan and Neher, *Phys. Rev.*, **53**, 855 (1938).
[3] Lemaître and Vallarta, *Phys. Rev.*, **43**, 87 (1933).
[4] Jánossy, *Z. Phys.*, **104**, 430 (1937).
[5] Vallarta, NATURE, **139**, 839 (1937).
[6] Epstein, *Phys. Rev.*, **53**, 862 (1938).
[7] Lange and Forbush, *Terr. Mag.*, **47**, 185 (1942).

Composition of Chlorine Hydrate

THE composition of chlorine hydrate has been the subject of much experimental work. Faraday, by analysis, found the composition to be $Cl_2.10H_2O$. The composition has also been determined analytically by Roozeboom[1] who found $Cl_2.8H_2O$, Bouzat and Azinières[2] who found $Cl_2.6H_2O$, and more recently by Anwar-Ullah[3] who agreed with this last formula. De Forcrand[4] used an empirical rule to calculate the number of molecules of water present. According to de Forcrand's rule, if ΔH is the heat of dissociation of the hydrate into gaseous chlorine and ice, and T the temperature at which the dissociation pressure is 760 mm., then $\Delta H/T$ is a constant the value of which is approximately 30. The value of T is known from the dissociation pressures determined experimentally by Roozeboom, and this gives a value of ΔH equal to 8,478 cal./gm. mol. Since de Forcrand's rule is only an approximation, this value of ΔH is very inaccurate. De Forcrand determined the heat of dissociation of the hydrate into gaseous chlorine and water by measuring the heat of solution of the hydrate in water and obtained a value of 18,360 cal./gm. mol. The number of molecules of water present in the hydrate is then given by $n = 18{,}360 - 8{,}478/1{,}436 = 6{\cdot}88$, the latent heat of fusion of ice being 1,436 cal./gm. mol. De Forcrand therefore assumed the composition to be $Cl_2.7H_2O$.

The true composition of the hydrate can be found by calculating the heats of dissociation into gaseous chlorine and ice, and gaseous chlorine and water respectively, using the dissociation pressure data of Roozeboom[1]. The graph of $\log p$ against $1/T$ is found to be linear in both cases, and from the slopes of the two lines the heats of dissociation are respectively 6,413 and 17,870 cal./gm. mol. The number of molecules of water in the chlorine hydrate molecule is thus $17{,}870 - 6{,}413/1{,}436 = 7{\cdot}97$; and there is little doubt, therefore, that the correct formula is $Cl_2.8H_2O$.

IVAN HARRIS.

3 Beech Tree Bank,
Rectory Lane,
Prestwich,
Manchester.
Feb. 12.

[1] Roozeboom, *Rec. Trav. Chim.*, **3**, 68, 1884; **4**, 65, 1885.
[2] Bouzat and Azinières, *C.R.*, **77**, 1444 (1923).
[3] Anwar-Ullah, *J. Chem. Soc.*, 1172 (1932).
[4] De Forcrand, *C.R.*, **133**, 1304 (1901); **134**, 743, 768, 835, 991 (1902).

Name for Element 85

MAY I be permitted to register a protest at the ungainly name suggested for element 85 by Mrs. A. Leigh-Smith and A. Minder[1]. The more science has been divorced from the humanities the more has mankind been afflicted by unpleasing words. Even so, this word 'anglo-helvetium' surely exceeds the limits of toleration. Assuming its existence to be confirmed and the chemistry of this element to be worked out, are we to talk of hydroanglo-helvetic acid (formula HAh perhaps) and of the peranglo-helvetates? By comparison with the possibilities which might be made of anglo-helvetium, we may come to regard dysprosium and praseodymium as old friends.

I make no claim to special knowledge of the English or classical tongues, but it does seem reasonable to suppose that since the other halogens have been named so elegantly from the Greek, it might be possible to find a fairly short word similarly derived which could serve as a name for this last halogen. The word 'leptine' (Greek *leptos*) has been suggested to me, but I mention it merely to illustrate the sort of thing that might be done to provide a euphonious and reasonably short word which could be easily transcribed into the principal European languages.

C. W. MARTIN.

King Edward's Grammar School,
Five Ways, Birmingham,
c/o Monmouth School,
Monmouth.

[1] NATURE, **150**, 767 (1942).

LEAF ANALYSIS AS A GUIDE TO SOIL FERTILITY

By PROF. H. LUNDEGÅRDH
University, Uppsala

ONE way of investigating agricultural soils is by leaf analysis. The fundamental idea behind this method is that the amount of nutrient salts absorbed by the plant reflects the available amount of these salts in the soil. Whereas earlier trials along this line dealt with the storage of salts in the mature plant, for example, hay, or in seedlings, leaf analysis is based on the functioning assimilating leaves as the central 'laboratories of nutrition'.

The concentration of salts in leaves is regulated by the absorption power of the roots; and the growth of the whole plant, including the formation of seeds, is again controlled by the transformation of the nutrient salts proceeding in the green, assimilating leaves. If samples of the leaves of cereals, potatoes, clover, etc., are collected at the flowering stage, the percentage of nitrogen, potassium, calcium and phosphoric acid in the dried material gives an expression

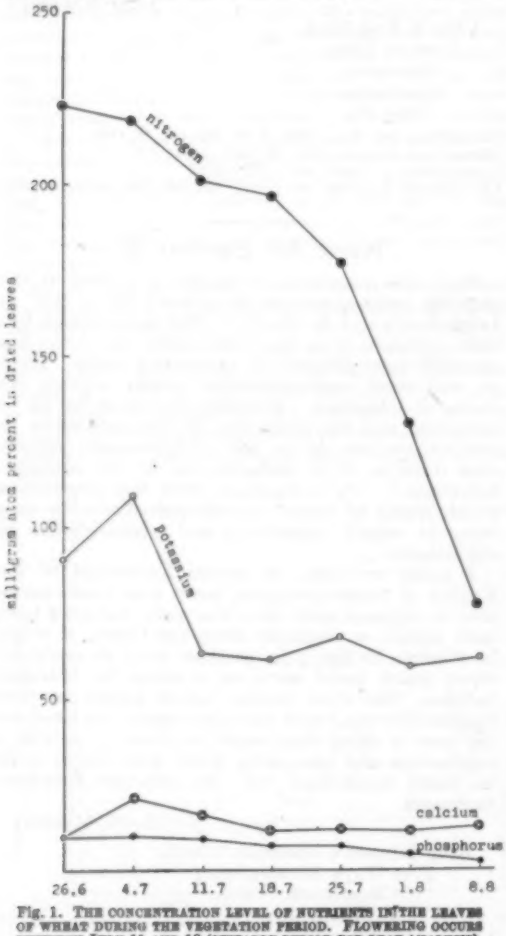


Fig. 1. THE CONCENTRATION LEVEL OF NUTRIENTS IN THE LEAVES OF WHEAT DURING THE VEGETATION PERIOD. FLOWERING OCCURS BETWEEN JULY 11 AND 18 (SUITABLE PERIOD FOR LEAF ANALYSIS).

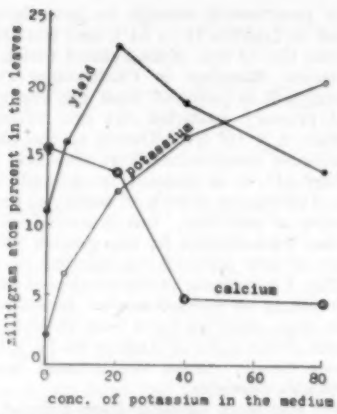


FIG. 2. ION ANTAGONISM BETWEEN POTASSIUM AND CALCIUM (OATS). INCREASE OF POTASSIUM IN THE PLANT SUPPRESSES THE ABSORPTION OF CALCIUM; AS A CONSEQUENCE THE YIELD DECREASES.

of the available amounts of these nutrients in the soil (Fig. 1). The idea of leaf analysis has been worked out in my laboratory since 1929 and was first published in 1934[1]. In France and the United States, too, studies of leaf analysis ('foliar diagnosis') have been performed independently[2,3].

My idea of leaf analysis had its origin in the fact that, as shown by pot experiments and field experiments, each nutrient factor must be present in a certain minimum concentration in the green parts of the plant, unless the growth is to be seriously checked. It was furthermore demonstrated that, whereas in some cases the concentration of salts within the plant rises in proportion to the concentration in the medium, in some cases ion antagonism and other disturbing factors seriously derange these relations. It is a well-known fact that the accumulation of potassium within the plant suppresses the absorption of calcium, even if this element is present in normal amounts in the soil. If antagonism brings the inner calcium concentration down below the limit, the growth is inevitably retarded (Fig. 2). Such experiments were varied in several ways, and they always illustrated the thesis that the growth and yield of the plants are regulated by the amount of nutrient salts actually present in the green, assimilating parts of the plant. Leaf analysis is thus a sort of integration of all circumstances which influence the availability of the salts in the soil, and it includes also the nitrogen, one of the most prominent factors of nutrition. The determination of nitrogen by chemical analysis of the soil is misleading, because available nitrogen is continuously produced by micro-organisms, which get part of their nitrogen from the atmosphere.

The practical value of leaf analysis was tested by comparing the analytical data with the results of field experiments. During 1938 and 1939 about eight hundred such experiments were carried out in different parts of Sweden. Leaf analysis was made on samples from non-fertilized plots. These figures were compared with the difference in yield as between fertilized and non-fertilized plots. In spite of the inevitably large experimental errors with field experiments, the agreement was surprisingly good.

Plotting the leaf analysis values of potassium against the surplus of yield after treatment with potassium fertilizers, we get a curve approximating

a hyperbola. Similar curves were obtained in respect of the nitrogen content of the leaves and the effect of nitrogen fertilizers. Phosphoric acid also revealed the same principal rule, namely, an approximately inverse relation between the concentration of phosphorus in the leaves and the increase in yield after treatment of the soil with superphosphate. Moreover, the leaf analysis demonstrated the co-operation of the nutrient factors according to the principle of limiting factors.

An example of the interaction of potassium and phosphorus is illustrated by Fig. 3: if the soil suffers from phosphorus deficiency (= low P-value in the leaves), fertilization with potassium salt alone will yield less than if superphosphate were added. Similarly, leaf analysis enables us to decide whether superphosphate will pay without simultaneous nitrate fertilization or not.

The advantages of leaf analyses, compared with soil analysis, are summed up as follows: the plant will indicate more precisely the availability of the

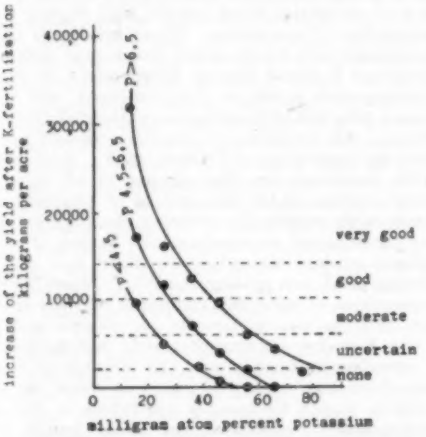


Fig. 3. PROBABLE EFFECT ON THE YIELD OF FERTILIZATION WITH 60 KGM. 40 PER CENT POTASSIUM SALT PER ACRE. A LOW CONTENT OF POTASSIUM IN THE LEAVES INDICATES GOOD RESULTS, HIGH CONTENTS LESS GOOD, ETC. INCREASING SUPPLY OF PHOSPHORUS RAISES THE UTILIZATION OF POTASSIUM.

nutrient salts in the soil, because it has its own methods of extraction. Moreover, leaf analysis gives not only an instantaneous picture of the situation in the soil, but also sums up the extraction of salts during a period of several weeks, for the samples are taken at a stage when the vegetative parts of the plant are fully grown but still vigorous. This viewpoint is important, not only in respect of the availability of nitrogen, but also in respect of potassium, phosphoric acid and calcium, which components are extracted from the soil by the joint action of the roots and the soil micro-organisms.

A drawback connected with the method of leaf analysis is the variability of the environmental factors, especially rainfall and temperature. As the samples are taken at a comparatively early date, variations in the second part of the season have no influence. But a dry summer tends to raise the concentration of nutrient elements in the leaves, whereas a wet period influences the development in the opposite direction. The experience of the last five summers, with their large amplitude of temperature and rainfall, teaches that samples taken on the same plot reveal certain variations in respect of leaf analysis, but these variations are reasonably limited. The method of leaf analysis will thus probably be of some value in teaching the farmer how to economize with mineral fertilizers and how to use them in the right proportions.

[1] Lundegårdh, H., "Die Nährstoffaufnahme der Pflanze", Jena, 1932; *Ann. Agric. Coll. Sweden*, **9**, 127 (1941).
[2] Lagatu, H., and Maume, L., *Ann. Ecole Nat. Agr. Montpellier*, Prem. mém., **20**, 219 (1930).
[3] Thomas, W., *Plant Physiol.*, **12**, 571 (1937).

PLANNING POST-WAR BRITAIN*

THE Institution of Municipal and County Engineers has prepared a report in consequence of the Government's acceptance of the principle of planning on a national scale. The national plan should, it is suggested, be prepared on broad lines by a ministerial department which should lay down general principles for the whole of Great Britain. These should deal with policy, standards and national details, such as communications, zoning as affecting national parks, preservation of mountains, moorlands, recreational coastline, forestry, etc., and electricity, gas and water supply. Under policy would come such matters as enabling legislation, agricultural systems, distribution of industry and of population, while under standards would be considered minimum conditions of housing, industrial and commercial zoning and lay-out and recreational facilities.

Local authorities, it is suggested, should remain responsible for detailed planning, together with allied matters such as drainage, road-making, bridge-building and housing, but to secure co-ordination of detail over wider areas there should be a statutory obligation on local authorities within a particular region to collaborate in the preparation of a unified scheme. The boundaries of regional schemes should be defined by the central authority in consultation with local authorities. They should be fixed more with the view of community of interest and topographical considerations than of local government areas.

A major section of the report is then devoted to national and regional communications, and a Government investigation of the whole subject in all its bearings on the life of the community is recommended as a basis for planning. In regard to railways, it is recommended that any necessary financial or other assistance should be provided without restricting other forms of transport. More use of canals and water-ways for the transport of heavy goods is recommended to relieve congestion on railways and roads, but the major feature of this section is the recommendation regarding the provision of high-speed motor-ways—single-purpose roads restricted to motor vehicles—a proposal which was urged with great force by Lord Sempill in the House of Lords debate on November 19.

Dealing with the development of built-up areas as part of a complete town plan, the report insists that the planning authority for a district must decide the type of buildings on a site and lay down the standards for the widths of roads, heights of buildings, general style of architecture, housing density, etc. The complete plan of any town or the redevelopment of particular districts must keep in mind the provision of

* Post-war Planning and Reconstruction. Pp. 48. (London: Institution of Municipal and County Engineers, 1942.) 1s.

adequate communications and parking facilities, preservation of the historic character of the town, ancient monuments, well-known thoroughfares, etc., spaciousness in suitable districts combined with compactness of design on building sites, and grouping of civic buildings, shopping, museums and recreational facilities according to their character and demand. In regard to the establishment of satellite towns, the report suggests that the first step should be an analysis of residential requirements. This should include a survey of existing residential development and the extent of over-crowding, the consideration of types of residential development required and maximum densities, and a survey of reservations of land at present used for residential purposes, with the object of distributing the existing industrial or business development and providing the needed areas of open space, playing fields, etc.

On the establishment of new industries in existing towns the report urges that factors such as the more equitable distribution of the world's raw materials, the state of Great Britain's heavy industries due to increasing production in foreign countries and a policy of emigration to develop the resources of the Empire make the proper distribution of existing industries more important than the establishment of new ones. New industries should be located in suitable places throughout the country in or adjacent to existing towns which have suffered from depression, the environs and needs of which have been properly planned and considered beforehand. Care should be taken that agricultural life is not disturbed and that agriculture is given its rightful place as a vital industry, the rural surroundings of a town being regarded as a natural and essential complement to a well-balanced urban community. The suitability of light industries for the fringes of country towns once again receives recognition, while the serious monetary problems which the law at present offers in planning agricultural belts and parkways between existing towns and future growths is firmly emphasized in a plea for enactment of a bolder and more equitable policy. In particular, a planning authority should no longer be liable to compensate owners of agricultural land for the loss of potential development value which never existed.

Attention is then directed to problems of regional drainage, both of surface-water and of foul-water drainage, including the purification of sewage and trade waste. The boundaries of the regional authorities undertaking these matters should be dictated by geographical considerations and would not necessarily coincide with the boundaries set up for the purpose of unifying local government on a regional basis. Similarly, while it is recommended that the water policy of Great Britain should be guided nationally by a central authority, directly responsible to Parliament, with power to control and co-ordinate all water sources, the central authority's administrative powers should be devolved on regional bodies, also possessing statutory authority, and controlling areas related to the areas of the respective watersheds grouped with suitable districts. A comprehensive and accurate investigation of all water resources, whether above or below ground, the consolidation and modernization of water legislation, including the simplification of the control of rivers, and an overhaul of the present system of rating water undertakings are further recommendations.

In the section on desirable standards for buildings, buildings and light angles, the report has special weight. The Institution of Municipal and County Engineers has frequently had to protest to the building by-laws section of the Ministry of Health at recent weakening of the by-laws relating to building and the forcing of them on unwilling and protesting local authorities, which has resulted in a decrease in structural stability and health protection. Some of the Institution's contentions as to the small factor of safety have been confirmed by the recent disastrous effect of blast, hundreds of yards from single detonations, on the large breeze-block, lath-and-plaster type of building erected under new by-laws, as against the stability of habitations, close to the explosion, erected under old regulations. The report submits that the clauses in future issues of model by-laws should be the result of decisions taken by a representative committee of those affected by such by-laws, including adequate representation of the Institution, having regard to the responsibilities of its members for enforcing such by-laws.

The final section of the report details desirable standards for highways, parkways, services, recreation and industrial development with regard to the preservation of amenities. These are based on the assumptions that a high-speed motor-road policy will be adopted in Great Britain independent of existing highways, with a link to the Continent, and that a national plan will give guidance on the distribution of services. All questions of planning should be controlled by a minister of Cabinet rank. Among these specific proposals are the placing of all signs and advertisements under the control of planning committees with powers for securing the removal of all signs detrimental to amenity, the taxing of all advertising posters according to their size and the licensing of all advertising stations. Street lighting, the provision of adequate car parks and the enforcement of their use, control of woodlands and trees by the Forestry Commission after agreement with the planning authorities and the removal of noxious trades from the centres of towns to zones the siting of which is not necessarily restricted to the local Parliamentary boundaries, are other points which illustrate the way in which this admirable report indicates the action required to implement an effective policy of planning. The extent to which the recommendations endorse those of the Scott and the Uthwatt Reports is notable.

HEALTH SERVICES IN GREAT BRITAIN

DR. JOAN McMICHAEL, speaking on February 21 at a Conference on Health attended by trade union leaders and held at the Conway Hall, London, voiced the dissatisfaction of many trade union officials and workers in the health services of Great Britain at the great loss to the war effort from illness in industry. Apart from the great increase in the incidence of tuberculosis and venereal disease, much of this morbidity is due to colds, influenza and accidents; these were largely attributed to the influx into factories of persons unaccustomed to industrial conditions, and adversely affected by the long hours of shift work in factories. The black-out, the inadequate arrangements for married women, the shortage of doctors and nurses, and anxiety-states due to the War also contribute. To

help reduce this loss of work she recommended the development in factories of Workers' Health Committees, as sub-committees of workers' committees or joint production committees. These new committees should act as workers' health and safety inspectors, should collaborate with medical men to conduct health education in factories, investigate the usefulness to workers of mental stimuli such as music and film shows, suggest arrangements for special cases such as antenatal examinations for pregnant workers, and co-operate with other health-promoting bodies in the district. She further suggested that the powers of local authorities under Section 8 of the Factory Act should be extended to cover cleanliness, ventilation, lighting, temperature and overcrowding; and that a State industrial medical service responsible to the Ministry of Health should be introduced, sharing and applying the results of research.

Dr. Mark Daniels, reviewing the state of the health services in the London boroughs, considered that many of the difficulties in health matters are due to inadequate use of the existing facilities. On the credit side, there had been no major epidemics, no fall in the level of nutrition of school children (except, significantly, in those entering school at age five), while communal feeding has been extended, and preferential treatment has been given by the Ministry of Food to heavy manual workers, expectant mothers and young children. On the debit side, there is the increase in tuberculosis, infantile mortality and deaths in childbirth, and a definite increase in diphtheria and venereal disease. Though the Ministries have made numbers of excellent recommendations, it is none too easy to get them carried out; the available arrangements are often not used to the full, owing to the inadequate education of the public in medical matters. He instanced the failure to make full use of facilities for immunization against diphtheria, for the treatment of venereal disease, and for the provision of cod liver oil and orange juice to expectant mothers. In his opinion, trade unions should lose no opportunity of raising health questions—should even devote whole conferences to health matters. To these conferences medical men should be invited so that they can get to know what the problems at hand really are. Trade unions could also assist in establishing the necessity for the provision of communal feeding centres, for shopping and transport facilities for workers, and for social and recreative facilities, especially for young persons. They could also help in petitioning for war-time nurseries and school canteens.

Sister Mary Morse contended that shortage of domestic staff aggravates the shortage of nurses, who are compelled to do non-nursing work. Nurses are overworked, and she said there is little doubt that the impossibility of giving proper attention to their patients, combined with delay in admitting sick persons to hospitals, greatly lengthens the period of illness. The shortage of nurses is due to the conditions under which nurses work in hospitals; she suggested that there is not much likelihood of improvement until nurses are organized, and the Essential Works Order and trade union machinery applied in hospitals. Though the Rushcliffe Report was a step in the right direction, the remuneration proposed for the very responsible ward sister is still inadequate, and domestic staff are not considered at all. The problem is urgent, as a 'second front' in Europe would make enormous demands on nurses. Moreover, she considered it scandalous that while there is so great a shortage of medical men the majority of the teaching hospitals in London still refuse women students.

An immediate step towards the solution of the nursing problem would be the formation of a joint consultative committee of nurses and other hospital staff, which would determine the best way in which the limited resources of the hospitals could combine for the improvement of hospital services.

Resolutions embodying the main suggestions of the two openers were passed unanimously by the Conference.

MEASUREMENT OF SHORT ELECTRIC WAVE-LENGTHS

AN article with a mathematical basis entitled "Wavelength Measurements of Decimetric, Centimetric and Millimetric Waves" by A. G. Clavier (*Elect. Comm.*, **20**, No. 4; 1942) considers the measurement of waves shorter than one metre, and describes apparatus specially adapted to this purpose. The measurement of these wave-lengths presents peculiar difficulties and necessitates the construction of specialized apparatus.

In the region of decimetric waves, it is still possible to construct an oscillating circuit of lumped electrical constants. The selectivity of such a circuit can easily be estimated by means of its magnification factor, derivable from low-frequency technique.

Certain considerations presented in the paper and the necessity of finding an easy method of calibration in terms of wave-length have led to the use of circuits with distributed constants and, in particular, transmission lines. In the first instance, transmission lines made up of two parallel Lecher wires were considered in which the separation between the wires is small compared with the wave-length; radiation can be ignored as a first approximation and Kirchhoff's laws applied by assigning line constants R, L, C to the line. For very high frequencies, leakance between wires may also be ignored.

Transmission lines with parallel wires are especially suitable for decimetric wave-lengths; the resonance positions are repeated periodically along the line and their separation gives the wave-length to be measured. Such lines, with variations, have been used by numerous experimenters.

Lecher-wire wave-meters are in current use for the measurement of decimetric waves, but they have the following disadvantages. Line radiation increases with the frequency; it is difficult to localize the excitation at one point of the line; it is not easy to eliminate effects due to surrounding objects and movements of the operator. It is consequently preferable to use coaxial lines, and a wave-meter of this type was designed in 1931.

Coaxial-line wave-meters may be used for the measurement of wave-length up to the centimetre wave-band. For wave-lengths of a few centimetres, however, the influence of the transverse dimensions of the coaxial line causes trouble, and coupling problems arise making dielectric guides necessary. The simplest of these consist merely of a metallic pipe without an inside conductor, and electromagnetic waves may be propagated through them provided the wave-length in air is below a certain

limit which is of the order of the diameter of the guide.

To measure wave-lengths with dielectric guides, it is necessary to transform the wave-lengths measured along the guide into the wave-length in air. In the present state of the art and with transmitted frequency stability available, it is possible to rely on the theoretical relationships established between these wave-lengths. It is advisable to work fairly closely to the cut-off wave-length, since in this region a relatively small variation in the frequency causes a considerable variation in the wave-length along the axis of the guide.

Measurements of wave-lengths of less than one centimetre have been made with equipment illustrated in the paper. The wave-length of a magnetron especially constructed for wave-lengths of this order required determination. The magnetron sent an H_1 wave into a guide of 0·5 cm. radius. A crystal detector was coupled to the guide and connected to a milliammeter. At the end of the guide a movable piston, which had very good high-frequency contacts with the wall of the guide, was displaced by a micrometer lead. Accuracy was increased by taking measurements at a certain number of half wave-lengths.

Other methods of measurement have been utilized. In particular, the quasioptical properties of these oscillations suggest the adaptation of interferometers and gratings. Thus, as might be expected, there is a tendency towards the technique of measurement used at the long end of the infra-red spectrum.

FORTHCOMING EVENTS

(Meetings marked with an asterisk are open to the public)

Saturday, March 13

TOWN AND COUNTRY PLANNING ASSOCIATION (in the Council Chamber, Moreton-in-Marsh, Glos.), at 2 p.m.—Conference on "Reconstruction and Country Life" (Principal Speaker: Dr. C. S. Orwin).*

Monday, March 15

ASSOCIATION OF AUSTRIAN ENGINEERS, CHEMISTS AND SCIENTIFIC WORKERS IN GREAT BRITAIN (at the Institution of Structural Engineers, 11 Upper Belgrave Street, London, S.W.1), at 7.30 p.m.—Dr. K. Mendelssohn: "Low Temperature Research".*

Tuesday, March 16

ROYAL SOCIETY OF ARTS (DOMINIONS AND COLONIES SECTION) (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Sir Harry Luke, K.C.M.G.: "The British Colonial Empire in the Pacific".

ROYAL INSTITUTION (at 21 Albemarle Street, Piccadilly, London, W.1), at 3 p.m.—Sir Henry Dale, G.B.E., P.R.S.: "Chemistry in Modern Medicinal Treatment", (i) "Pre-scientific Discoveries".*

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY (in Room No. 7, The University, Manchester), at 5 p.m.—Mr. A. L. Armstrong: "The Excavation of Pit 15, Grimes Graves, Norfolk, 1939, and Discovery of a Figurine of the Mother Goddess, associated with evidence of Ritual Worship".

Wednesday, March 17

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Mr. W. P. Hildred: "The Future of Air Transport".

INSTITUTE OF PHYSICS (JOINT MEETING WITH THE LONDON AND SOUTH-EASTERN COUNTIES' SECTION OF THE INSTITUTE OF CHEMISTRY) (at the Royal Institution, 21 Albemarle Street, Piccadilly, London, W.1), at 2.30 p.m.—Mr. E. D. Eyles: "High-Speed Kinematography".

GEOLOGICAL SOCIETY OF LONDON (at Burlington House, Piccadilly, London, W.1), at 3 p.m.—Annual General Meeting.

ROYAL METEOROLOGICAL SOCIETY (at 49 Cromwell Road, South Kensington, London, S.W.7), at 4.30 p.m.—Prof. Herbert Dingle: "Atoms, Molecules and Radiation" (G. J. Symons Memorial Lecture).

Thursday, March 18

LONDON MATHEMATICAL SOCIETY (at the Royal Astronomical Society, Burlington House, Piccadilly, London, W.1), at 3 p.m.—Prof. H. Simpson: "Some Problems in Statistical Theory".

ASSOCIATION OF SCIENTIFIC WORKERS (IN CO-OPERATION WITH THE WOOLWICH AMENITIES COMMITTEE) (in the Council Chamber, Town Hall, Woolwich, London, S.E.18), at 7.15 p.m.—Sir Robert Watson-Watt, F.R.S.: "The Scientific and Technical Worker in the Public Service".

Friday, March 19

ROYAL INSTITUTION (at 21 Albemarle Street, Piccadilly, London, W.1), at 5 p.m.—Sir Alfred Egerton, F.R.S.: "Warmth and Comfort Indoors".

Saturday, March 20—Sunday, March 21

BRITISH ASSOCIATION (DIVISION FOR THE SOCIAL AND INTERNATIONAL RELATIONS OF SCIENCE) (at the Royal Institution, 21 Albemarle Street, Piccadilly, London, W.1).—Conference on "Science and the Citizen, the Public Understanding of Science".*

Saturday, March 20

10 a.m.—"The Exposition of Science".
(Chairman: Sir Henry Dale, G.B.E., P.R.S.).

2.15 p.m.—"Radio and the Cinema".
(Chairman: Sir Allan Powell).

Sunday, March 21

10 a.m.—"Science as a Humanity".
(Chairman: Prof. J. L. Myres).

2.15 p.m.—"Science and the Press".
(Chairman: Sir Richard Gregory, Bart., F.R.S.).

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

ASSISTANT MASTER TO TEACH PRINCIPALLY ENGINEERING WORKSHOP PRACTICE AND DRAWING, in the Junior Technical School of Whitwood Technical College—Mr. M. G. Swaine, 97 Smawthorne Lane, Castleford, Yorks. (March 20).

TEACHER OF MATHEMATICS, TECHNICAL DRAWING, AND ONE WORKSHOP SUBJECT, PREFERABLY WOODWORK OR JOINERY AND CARPENTRY, in the Dinnington-Chelmsford Junior Technical School—Mr. G. E. Nicholson, Orchard Chambers, Church Street, Sheffield 1 (March 20).

TEACHERS FOR (*a*) MECHANICAL ENGINEERING SUBJECTS, (*b*) MATHEMATICS AND PHYSICS, in the Smethwick Municipal College—The Chief Education Officer, Education Offices, 215 High Street, Smethwick 41 (March 22).

LECTURERS IN (*a*) MECHANICAL ENGINEERING, (*b*) ELECTRICAL ENGINEERING—The Registrar, Loughborough College, Loughborough, Leics. (March 22).

DEPUTY CHIEF ENGINEER AND MANAGER OF THE BIRMINGHAM ELECTRIC SUPPLY DEPARTMENT—The Chief Engineer and Manager, 14 Dale End, Birmingham (endorsed 'Deputy Chief Engineer and Manager') (March 30).

CHAIR OF CHEMISTRY in the University College of North Wales—The Bursar and Acting Registrar, University College of North Wales, Bangor (April 3).

SPEECH THERAPIST—The Education Officer, County Hall, Wakefield.

LECTURER IN ENGLISH for British Institute, Leopoldville, Belgian Congo, to teach English to European adults and assist in Cultural Activities—The British Council, 3 Hanover Street, London, W.1 (endorsed 'Leopoldville').

ASSISTANT WORKS MANAGER (OPTICAL) for new instrument factory, Indian Ordnance Services—The Ministry of Labour and National Service, Central (Technical and Scientific) Register, Ref. C.1500, Alexandra House, Kingsway, London, W.C.2.

LECTURERS (FULL-TIME OR PART-TIME) IN MECHANICAL AND ELECTRICAL ENGINEERING SUBJECTS—The Ministry of Labour and National Service, Central (Technical and Scientific) Register, Section D.565, Alexandra House, Kingsway, London, W.C.2.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

University of Birmingham. Report of the Vice-Chancellor and Principal to the Council for the Forty-second Session 1941–1942. Pp. 20. (Birmingham: The University.) [291

Other Countries

New Zealand. Sixteenth Annual Report of the Department of Scientific and Industrial Research. Pp. 34. (Wellington: Government Printer.) 1*s.* [291

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